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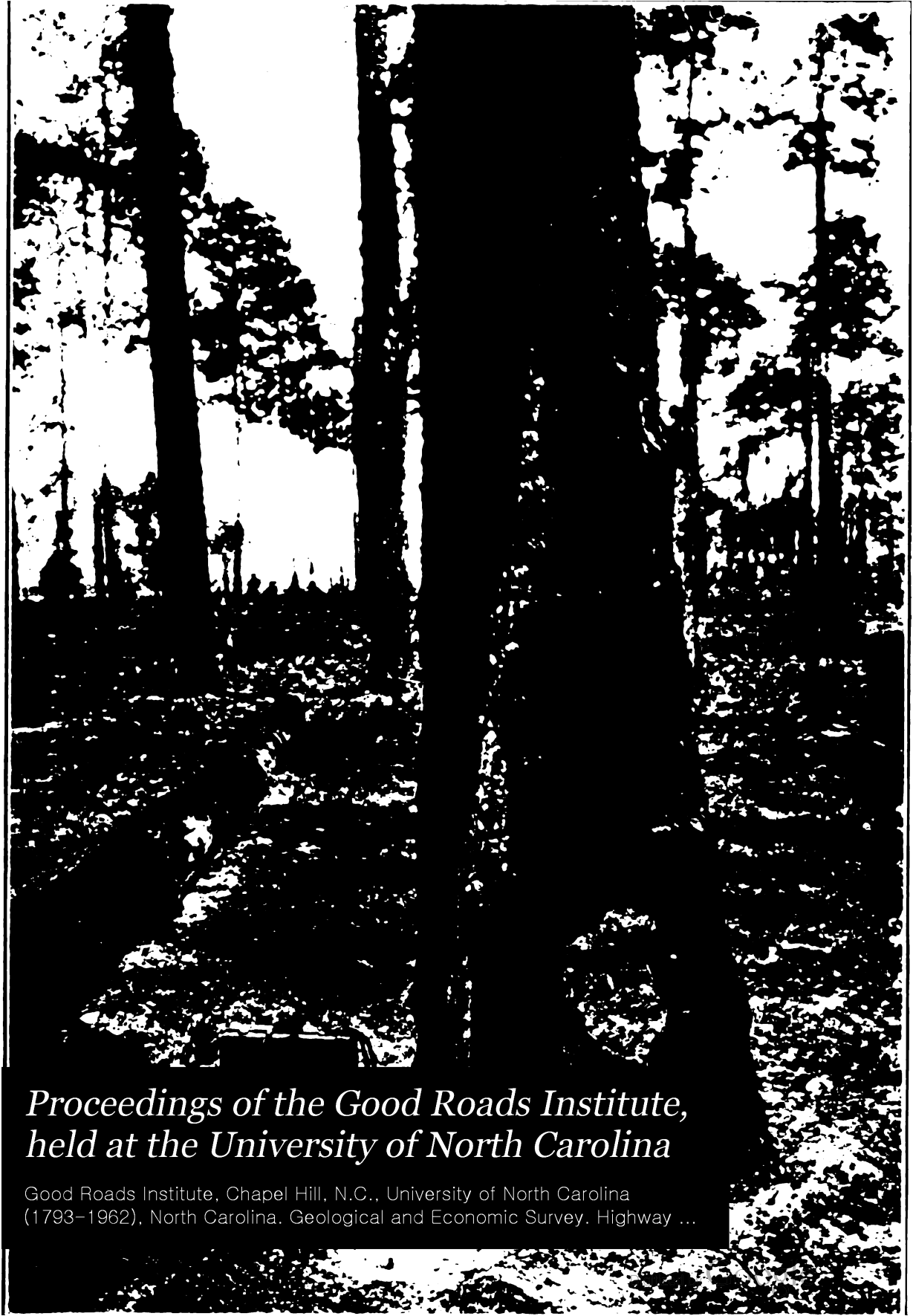
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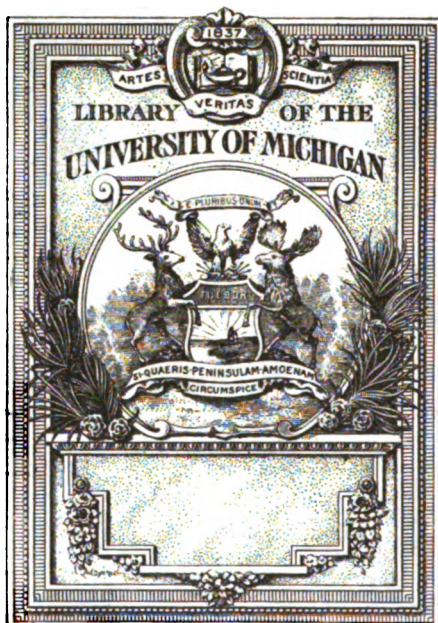
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*Proceedings of the Good Roads Institute,
held at the University of North Carolina*

Good Roads Institute, Chapel Hill, N.C., University of North Carolina
(1793-1962), North Carolina. Geological and Economic Survey. Highway ...



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**NORTH CAROLINA GEOLOGICAL AND
ECONOMIC SURVEY**

JOSEPH HYDE PRATT, STATE GEOLOGIST

ECONOMIC PAPER NO. 16

**Report of Convention Called by Governor
R. B. Glenn to Investigate the Fishing
Industries in North Carolina**

**COMPILED BY
JOSEPH HYDE PRATT**



RALEIGH
E. M. UZZELL & Co., STATE PRINTERS AND BINDERS
1908

**REPORT OF CONVENTION CALLED BY GOVERNOR R. B. GLENN
TO INVESTIGATE THE FISHING INDUSTRIES
IN NORTH CAROLINA**

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LETTER OF TRANSMITTAL

CHAPEL HILL, N. C., November 10, 1908.

*To his Excellency, HON. R. B. GLENN,
Governor of North Carolina.*

Sir.—The convention which you called to investigate the condition of the fishing industries in the State convened at Morehead City, August 26, 1908, and spent the following three days in a careful and thorough investigation of the condition of the fin-fish and shell-fish industries, and have recommended such legislation as they considered advisable to more thoroughly protect and conserve these fishing resources and increase the value of our fishing industries.

The proceedings of this convention, which have been compiled by its Chairman, are hereby respectfully submitted, and I would recommend that it be published as Economic Paper No. 16, of the North Carolina Geological and Economic Survey.

Yours respectfully,

JOSEPH HYDE PRATT,
State Geologist.

CONTENTS

	PAGE
LETTER OF TRANSMITTAL	5
INTRODUCTION	9
REPORT OF MEETINGS	10
Resolutions Presented	13
Beaufort County	13
Cumberland County	13
Currituck County	14
Dare County	14
New Hanover County	14
Pamlico County	15
Report of Fish Commissioner	15
Resolutions Adopted by Convention	21
Dutch-nets in Pamlico River.....	21
Game Warden's Right to Search Vessels.....	22
Dutch-nets in Carteret County.....	22
Dutch-nets in Albemarle Sound and its Tributaries.....	23
Dutch-nets in Pamlico and Albemarle Sounds.....	24
Net-stakes Removed from Certain Waters.....	26
Dutch-nets at the Inlets.....	27
Laws of 1907, Chapter 948, An Act to Regulate Fishing in Pamlico and Other Rivers.....	27
Power to Take Fish.....	28
License to Fish.....	28
License Tax	29
New General Legislation Recommended	29
Early Closing Season for Shad and Alewife or Herring.....	29
Double Seining	30
Protection of Sturgeon.....	30
Rockfish	30
Purse-net	30
Shad and Herring.....	30
Fishing on Sunday.....	31
Pound-nets on East Side of Roanoke Island.....	31
Closed Season for Fresh-water Fish.....	31
Removal of Nets.....	31
Fines	31
Resolutions Relating to the Terrapin	31
Diamond-back Terrapin Protected.....	31
Resolutions Relating to the Oyster Industry	32
Natural, Defined	32
Oysters—Where Purchased to be Carried Out of the State.....	33
Larceny of Oysters on Private Beds.....	33
Oysters Caught at Night.....	33

	PAGE
General Oyster Laws Recommended.....	34
North Carolina Shell-fish Commission.....	35
Inspectors, How Appointed.....	35
Office and Clerical Force.....	36
Equipment	36
Duties of the Shell-fish Commissioner.....	36
Arrests Without Warrant.....	37
Power to Take Oysters and Clams.....	37
Salaries	37
No Interest in Oyster Fisheries.....	37
Revenue	37
Cultivation of the Oyster and Clam.....	37
Shell-fish Commissioner Can Lease Bottoms.....	37
Leasing of Bottoms.....	38
Lease, How Obtained.....	38
Marking and Staking of Leased Bottoms.....	39
Term of Lease, Rental.....	40
Transfer of Lease.....	40
Re-leasing of Bottoms.....	40
Forfeiture of Lease.....	41
Title Secure	41
Delivery of Oysters Without Inspection.....	42
Special Resolutions Passed by Committee.....	42

Report of Fisheries Convention Held at Morehead City, North Carolina, August 26 and 27, 1908

Compiled by JOSEPH HYDE PRATT.

INTRODUCTION.

The convention called by Governor R. B. Glenn to investigate the condition of the fish and oyster industries of the State and to suggest legislation that would adequately protect and conserve these natural resources of the State and increase in value the fishing industries, convened at Morehead City on the morning of August 26, 1908. The delegates to this convention were appointed in the following manner: One delegate was appointed by the Governor and requested to call a meeting in his county to elect two other delegates to the convention. The following letter was sent out by His Excellency, Governor R. B. Glenn, to J. F. Tayloe, Washington, Beaufort County; Geo. Smithson, Coleraine, Bertie County; R. S. White, Elizabethtown, Bladen county; M. C. Guthrie, Southport, Brunswick County; T. B. Godfrey, Shiloh, Camden County; Charles Hill, Atlantic, Carteret County; T. H. Shepard, Edenton, Chowan County; Geo. N. Ives, Newbern, Craven County; W. L. Hawley, Fayetteville, Cumberland County; W. J. Tate, Kittyhawk, Currituck County; R. W. Smith, Manteo, Dare County; P. J. Cross, Gatesville, Gates County; B. F. Williams, Harrellsville, Hertford County; William Watson, Swanquarter, Hyde County; D. J. Fergus, Wilmington, New Hanover County; P. L. Woodard, Pamlico, Pamlico County; W. W. Mann, Elizabeth City, Pasquotank County; J. F. Foy, Scotts Hill, Pender County; Ned Winslow, Hertford, Perquimans County; J. J. Laughinghouse, Greenville, Pitt County; Geo. L. Liverman, Columbia, Tyrrell County; W. H. Hampton, Plymouth, Washington County:

Sir.—In order to facilitate further investigations relating to the condition of the fish and oyster industries of North Carolina, I do hereby appoint you a delegate to a convention to be held the latter part of August or early in September, and I also request you to call a meeting of the fishermen of your county at as early a date as possible to elect two other members to this fish and oyster convention who, with you, will represent your county. At your county meeting, ascertain as clearly as possible the sentiments of your people



regarding the protection of the fish and oyster industries and their ideas as to how the Fish and Oyster Commimssions can be made more effective.

This will be a most important convention and it is to the interest of the State and your county that it be represented. As soon as a meeting is held, notify me who have been elected as delegates. Unfortunately there is no way to reimburse the delegates for their expenses in attending this meeting.

Trusting to hear favorably from you regarding the above at an early date, I am,

Yours very truly,

R. B. GLENN,

Governor.

In response to this letter meetings were held in 19 counties of eastern North Carolina, and two other delegates elected who were then regularly appointed by the Governor.

REPORT OF MEETINGS.

The convention was called to order by Joseph Hyde Pratt, State Geologist, and the following counties responded to the roll-call: Beaufort, Bertie, Bladen, Brunswick, Carteret, Chowan, Currituck, Cumberland, Dare, Hyde, New Hanover, Pasquotank, Pender, Pitt, Tyrrell and Washington.

The temporary chairman was then elected permanent chairman, and W. J. Tate, of Kittyhawk, Currituck County, secretary.

The chairman discussed briefly the object of the convention and the line of work that it was desired to take up, speaking as follows:

"There is no doubt but that the supply of edible fish in the waters of North Carolina is becoming less and less each year. There are two facts which are responsible for this condition; first, insufficient laws for the protection of the fish; second, non-enforcement of the laws that have been passed.

"The falling off in the catch of fish is not due to the excessive use of any particular apparatus, but of over-fishing, and the permitting to fish apparatus in places where it ought not to be used. It is not due to the purse-netter, the pound-, seine-, or gill-netters, but to a combination of all, the State having permitted their use with little or no restriction. This privilege has been most outrageously abused and you fishermen know the result. With no adequate means of enforcing a law, it soon becomes a dead letter and many a fisherman is apt to catch fish in and out of season, of any size, with any kind of apparatus, because he thinks that if *he does not* some other fisherman will. In this way hundreds of thousands of small fish are caught which, if permitted to remain in the water, would in a year or two become valuable edible fish. The small fish caught in this way are often dumped on the shore, used as fertilizer,

1901

or shipped to market, with a faint hope that they may be marketable, but usually they are thrown out by the dealer.

"If the small fish are destroyed (by whatever means), it is a self-evident fact that there will soon be a scarcity of large ones and finally certain fish will become extinct in the waters of North Carolina. The size of the mesh ordinarily used by the pound-netters, and the seine-haulers has undoubtedly considerable to do with the destruction of small fish; but, whatever the reasons may be, it is obviously necessary that some means must be taken to obviate this condition and prevent the public from being deprived of such an important article of food, and the fishermen of an occupation.

"Not only is there a wholesale destruction of small fish, but the amount of apparatus fished in the State is considerably greater than the fisheries of the State can support. We have placed little or no restriction on the amount of apparatus that can be fished, and made hardly any attempt, except in a small territory, to enforce the laws that have been passed with a view to protect the fish.

"I am not putting it too strongly when I say that if the fishermen will not consult self-interest enough to protect the fishing industry of their own accord, they should be *made to do it*. Why? Because they are not the only ones interested in the fishes of North Carolina. Every man, woman and child in North Carolina has an interest in the fish of the State. They are vitally interested in the conservation of the fishing resources of the State. Every one of them as a citizen of North Carolina has a perfect and constitutional right to fish in any of the waters belonging to the State, to come to eastern North Carolina for a certain part of the year and make a business of fishing, taking their profits back with them to central and western North Carolina.

"The protection of the fish and the fostering of our fishing interests are not county questions but State questions; they are not questions of interest only to the individual but to the whole people; and, in passing laws to protect and foster our fishing industries, we must consider the State before the county and the whole people before the individual.

"I believe that the only adequate method of enforcing our fish laws and fostering our fishing industries is through a Fish Commission. A Commission that will not only see that the laws are enforced (and if there is a bad law, its enforcement will very quickly cause it to be repealed, and every law until it is repealed should be enforced), but also be able to carry on investigations relating to the various fishing industries; to study local conditions and be able to render a just decision regarding what is the best thing to be done for the best interests of the State.

"At every legislature there are introduced many bills relating to fishing in eastern North Carolina, nearly all of which are local in the benefits that are supposed will be derived by their passage, and have been drawn up regardless of the hardships or the injustice they may work on other sections of the same county or other counties; and no thought is given as to how it will affect the interests of the State.

"Two of the main questions that should receive the serious consideration of the convention are: The value of the Fish Commission to the State as a whole; and the necessity of passing adequate laws which will permit of the cultivation of oysters in the waters of North Carolina. Another question that we must consider is the protection of game fish in the mountain streams of the western part of the State and in this connection it would be well to take up the advisability of bringing under the jurisdiction of the Audubon Society the protection of the game fish in this section. We have with us as a delegate to the convention Mr. T. Gilbert Pearson, Secretary of the Audubon Society, who will later discuss this phase of the work."

The first question taken up for discussion was the value of the work of the Fish Commission to the State and regarding the extension of its jurisdiction. It was nearly unanimously acknowledged that the Fish Commission had been a benefit to the fishing industries in those counties under its jurisdiction and that it would be for the best interests of the State to have all the counties in eastern North Carolina in which commercial fishing is carried on come under the jurisdiction of the Fish Commission; but the convention was also of the opinion that it should not recommend that all the counties be forced to come under the jurisdiction of the Fish Commission.

Mr. T. Gilbert Pearson, Secretary of the State Audubon Society, addressed the convention at the afternoon meeting, August 26th, and stated in some detail the necessity of protecting our natural resources and showed how, with unrestrained hunting and fishing, the supply of birds and fish would grow scarcer and scarcer. Nature has made allowance for the destruction of a certain number of all kinds of animals by their natural enemies in the animal world, but when man steps in he creates an artificial condition with which nature finds it difficult or impossible to cope. We have two questions in connection with the conservation of these resources; first, to preserve what is here and second, to propagate. Each of these is as important as the other. Mr. Pearson stated that about 20 years ago there was something like \$11,000 spent in this country in the protection of game birds and fishes, while at the present time there are over \$2,000,000 spent annually. He showed how

it is impossible to protect the fish either on the coast of North Carolina or in the mountain streams without an adequate amount of money to carry on the work. In discussing the subject of the protection of game fishes in central and western North Carolina, Mr. Pearson stated that many persons interested in these had asked if the laws could not be amended in such a way that the wardens, acting under the Audubon Society, would have the enforcement of the laws relating to game fish in the western part of the State. Mr. Pearson was of the opinion that the State Audubon Society would gladly undertake this work of protecting the game fish in connection with their work of protecting the game birds.

A motion was, therefore, made and passed by the convention that it would be to the best interests of the Fish Commission and that the game fish could be better protected if this protection of the game fish in the middle and western counties should be brought under the jurisdiction of the State Audubon Society, provided the people of the central and western portions of the State desired it.

RESOLUTIONS PRESENTED.

The following resolutions were presented to the convention by the delegates from their respective counties.

BEAUFORT COUNTY.

Resolved, That the fishermen of Beaufort County are in favor of a closed season from the 20th of April to the 1st of June for the protection especially of shad and herring during their spawning season, and that all pound-nets, drag-nets of whatever description shall be taken out of the waters of Beaufort County during that period.

CUMBERLAND COUNTY.

Resolutions presented by Charles D. Jones.

WHEREAS, At Fayetteville, Cumberland County, N. C., the fishing for shad is done with bow-nets and during the fishing season freshets prevail about one-half the time, so that there is sufficient depth of water to enable an abundant supply of shad and other fish to pass to the spawning grounds; and,

WHEREAS, At Prospect Hall and at the Inlet at the mouth of the Cape Fear River, certain forms of fishing are being carried on which are detrimental to the interests of the general fishing industry; and,

WHEREAS, Special agents sent out by the U. S. Bureau of Fisheries have reported that these conditions are injurious to the fishing industries,

Be it Resolved, By the Fishermen of Cumberland County, that they request the Fish and Oyster Convention held at Morehead City, at the call of Governor R. B. Glenn, to consider these conditions to recommend such legislation as will protect the interests of both fishermen and consumer, and prevent the destructive and ruinous methods of fishing as mentioned above.

CURRITUCK COUNTY.

Resolutions presented by W. J. Tate.

WHEREAS, The fishing industry of Currituck County is practically confined to black bass, and as they are not a migratory fish, but are spawned and reared naturally in Currituck Sound; and,

WHEREAS, Currituck Sound produces from one-half to three-fourths of the total yield of the State; and,

WHEREAS, Currituck County has for years and is now jealously protecting this industry by local laws passed by our representatives, said laws making an early closing season sufficient for breeding purposes;

In view of the foregoing, we, your Committee, fail to see any benefits to be derived by our County in placing ourselves under the administration of the Fish Commission. We consider it unjust and a hardship upon us to be taxed to protect an industry that we are already giving intelligent protection. And we suggest that this meeting instruct our delegates to the Fish and Oyster Convention at Morehead City to use their best efforts to prevent Currituck County from coming under the administration of the Fish Commission.

DARE COUNTY.

Resolved, That the fishermen of Dare County be permitted to fish a distance of 4,000 yards from Long Shoal Point at right angles to a line running along the shoal, the nets to extend toward the west.

NEW HANOVER COUNTY.

Petition presented by Geo. H. Smith.

We, the undersigned, appointed delegates of New Hanover County, desire to place before this honorable body a few things that we consider of very great importance to our section.

ARTICLE 1. That the fishermen of our county may be allowed to fish one and one-eighth bar and upwards, but nothing less, upon the grounds that our waters are not used for breeding purposes. The depth of our fishing waters is from five to ten feet, and it is a well-established fact that such water depth is not used for breeding purposes at any time.

ART. 2. That there be a commissioner appointed to see that such laws shall be enforced in New Hanover County.

ART. 3. That each and every fisherman owning or fishing with net or seine in these waters shall be taxed a small amount to defray the said expense.

PAMLICO COUNTY.

The following petition, signed by over 200 citizens of Pamlico County, and addressed to His Excellency, Governor R. B. Glenn, was presented to the convention:

"We, the undersigned citizens of Pamlico County, respectfully ask you to take some steps to protect us against the taking up by entry of our natural oyster bottoms. Several entries have been made and grants secured for such oyster bottom as has been heretofore affording a support for many of our citizens during the oyster season. If it lies in your power, we would further ask you to annul these grants that have been issued for said bottom and give back to us our natural oyster grounds."

The report of the Fish Commissioner, Mr. Theo. S. Meekins, was submitted and read.

REPORT OF FISH COMMISSIONER.

MANTEO, N. C., August 14, 1908.

Members of the Convention:

Having been requested by Mr. Joseph Hyde Pratt, State Geologist, to present my views as to the present laws regulating fishing and to offer such changes and recommendations as my judgment dictates, I beg leave to submit the following:

In the first place, I shall endeavor to discuss such laws as are of a general nature, disregarding the great number of private and local measures which time and space now forbids, and deal with those affecting the greater number interested in the fish industry.

In my January report to the Geological and Economic Survey Board, I recommended the codification of the fishing laws for North Carolina. My reason for doing this was due to the vast number of Acts upon the statute books dealing with almost every locality where fishing is carried on to such an extent that it is almost impossible to ascertain what the law is, as applied generally, as each succeeding Legislature has been inclined to restrict the fishing industry, having as its object the promotion of the industry, thereby adding statute upon statute so that to-day one not versed in the law can make only a feeble attempt to state or execute the

law. This work of codification has been granted by the Board and in a short time will be ready for distribution.

Under the head of changes and recommendations, I respectfully submit the following:

First. That Section 2424 of the Revisal of 1905 be repealed for the reason that Section 2440 of the Revisal of 1905 makes the necessary restrictions.

Second. That Section 2428 of the Revisal of 1905 be repealed because Section 2429 of the Revisal of 1905 includes the former and makes the necessary restrictions, except the penalty, which should be added to Section 2429, and to this I recommend the following changes: That all after the word "year" in line 16 be repealed and in lieu thereof the following be inserted:

"That any person violating the provisions of this section shall be guilty of a misdemeanor and shall be fined not less than fifty dollars nor more than one hundred dollars in the discretion of the Court."

Third. That Section 2432 of the Revisal of 1905 be amended by omitting the word "authorized" in line four and inserting in lieu thereof the word "directed."

Fourth. That Section 2433 of the Revisal of 1905 be repealed. I make this recommendation because it is not practical and to enforce said section would stop all pound- and gill-net fishing within the limits named; in fact, would eliminate all fishing for commercial purposes within the boundaries named in said section.

Fifth. Section 2440 of the Revisal of 1905, commonly known as the Vann Bill, is in my opinion, after having one year's experience as Fish Commissioner, almost all the law necessary for such territory as it covers. With slight modifications, it is a wise law and one of vast importance to the fishing industry of the State. The survey made last winter was almost all the marking of the territory under this section.

In my opinion, this section should be changed so as to make the ten-mile S. E. line from Big Island, read five miles S. E. by E. one-eighth E. from Roanoke Marshes Light House, as recommended by Mr. W. F. Hill. I also recommend that one thousand yards be allowed around Hog Island Marsh instead of five hundred yards.

I respectfully call your attention to the situation on either side of Roanoke Marshes, and recommend that straight lines be run from the stake 2000 yards from the shore in the two and one-half mile radius from Roanoke Marshes Light House to 500 yards eastward from the point of Roanoke Marshes, and that straight lines be run from the stake one-fifth the width of Croatan Sound in the two and one-half radius from Roanoke

Marshes Light House south to the stake 500 yards from the eastward point of Roanoke Marshes. I also recommend that the provisions of this section, *so far as applies to pound-nets in Albemarle and Croatan sounds*, apply to the entire year instead of from January 15 to May 15 of each year.

The following is a copy of the report made by Mr. W. F. Hill; also a chart of the survey made under the directions of the Commission.

REPORT OF THE SURVEY OF NORTH CAROLINA FISHERIES, REFERRING TO DUTCH-
OR POUND-NET FISHING IN ALBEMARLE, CROATAN AND PAMLICO
SOUNDS, NORTH CAROLINA.

April 15, 1908.

The Commissioner, Bureau of Fisheries, Washington, D. C.:

Sir.—In consequence of a communication from the State Geologist of North Carolina, an extract from which follows:

*"Hon. Geo. M. Bowers, Commissioner, Bureau of Fisheries,
Washington, D. C.:*

Sir.—Regarding the assistance that I wish in connection with marking the boundaries, it is similar to that you did for us three years ago when Mr. Hill was detailed. We desire this time to have the boundary surveyed through Albemarle Sound and Chowan River, as well as Croatan Sound and the eastern part of Pamlico, as the territory represents that portion that comes under the control of the Fish Commissioner. If Mr. Hill could be detailed for the work, it would be of very great assistance to us.

I am writing to-day to Mr. Theodore S. Meekins, our Fish Commissioner, at Manteo, N. C., asking him to arrange for the boat with which to carry on the work and I will ask you to notify him if Mr. Hill can be detailed for the work and at what time.

Yours very truly,

(Signed) JOSEPH HYDE PRATT,
State Geologist."

I received your order No. 127, dated November 11, 1907, in pursuance of which preparations were made to carry out the survey as outlined in the request of the State Geologist of North Carolina.

The Coast and Geodetic Survey, responding to a request from the Bureau of Fisheries, supplied the necessary charts, description of triangulation stations and other data. By correspondence with the Fish Commissioner of North Carolina, the date and place for beginning the survey were fixed, viz., December 3, 1907, Edenton, N. C. Accordingly, I left Washington, D. C., the afternoon of December 2, 1907, and arrived in Edenton the afternoon of December 2, 1907. Several hours of December 2 were spent at the United States Engineer's Office in Norfolk, Va., searching for additional data for the Chowan River, which was thought might assist in the survey.

On December 3, 1907, the Fish Commissioner of North Carolina met me at Edenton with a gasoline launch chartered for the work. The survey began practically on the 3d of December, 1907, covering the area from Holiday's Island, Chowan River to Hatteras Inlet, Pamlico Sound. The distance traversed, including both sides of Chowan River, of Albemarle Sound, of the

northeast portion of Pamlico Sound, and the west side of Croatan Sound, was in round numbers, two hundred and forty miles, and distributed along this distance are 59 stakes, indicating the fishing area bounds.

The time limit designated for the accomplishment of this work was originally set at two months; but, owing to much unsuitable weather that delayed the work, this time limit was later extended.

A set of coast-survey charts, similar to the charts used and on which the survey was platted, was also made for the Fish Commissioner of North Carolina.

To the United States Coast and Geodetic Survey, for its courtesy in supplying charts and other necessary assistance, cordial thanks are extended.

Your attention is respectfully invited to the following remarks and recommendations.

Respectfully,

(Signed) W. T. Hill,*

Draftsman.

As is to be observed, the shore line is very irregular; consequently to have paralleled the shore line would have indefinitely protracted the time of the survey. The Fish Commissioner of North Carolina, therefore, decided to make the boundary (by stakes) only at the salient points and allow (verbal instructions to fisherman) the fisherman in the "bays" to extend their "set" out on the line between the stakes on either side of their "set." This adjustment apparently produced general satisfaction, with only two or three exceptions.

No boundary stakes were placed between the Alligator and Scuppernong Rivers on south side of Albemarle Sound, nor on the north side, from Pasquotank River to Roanoke Sound, as very little if any pound-net fishing is carried on in these localities, the probable cause of this, referring to the shore between the Alligator and Scuppernong Rivers, being such a long stretch of beach, with no harbors near, subjecting the fisherman consequently to danger from the northerly winds which prevail during the fishing season.

The method of locating the boundary was as follows:

A base line parallel with, and range at right angles to, the point of shore off which the boundary stake was to be placed, was led out by the compass (prismatic pocket) bearings, and measured; flag poles set at each end of the base line and on range. The distance from shore being known, and the direction being given by range, a right-angled triangle was presented for solution, which has the two sides, base and altitude, given, and the angle subtending the base at the distance off-shore, computed. This angle was set on the sextant and the boat run out on the range until the conditions above were satisfied, when the stake was placed.

This method was resorted to because it was found to be expedient and that a very close approximation to accuracy could be obtained. To have hunted up the Coast Survey triangulation stations, especially in the Albemarle Sound region, would have involved so much time and expense in the erection of the signals, etc., that it was abandoned at the outset as impractical for the subject in view.

It is therefore to be noted that the geographical position of the boundary

* Remarks by W. T. Hill referred to the survey and methods adopted in the execution thereof, see accompanying chart.

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CHART OF ALBEMARLE AND CROATAN SOUNDS AND A PORTION OF PAMLICO SOUND NORTH CAROLINA

COMPILED FROM U. S. C. AND G. S. CHARTS Nos. 140, 141, 142

The shaded portion indicates the area limited to ditch or pound net fishing during the period extending from January 15 to May 15 of each year, as prescribed by an act of the Legislature of North Carolina in 1906.

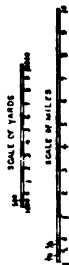
The location of the boundary stakes defining the prescribed area was determined by the U. S. Bureau of Fisheries in December, 1907, and January and February, 1908.

Symbols

Area limited to ditch or pound net fishing

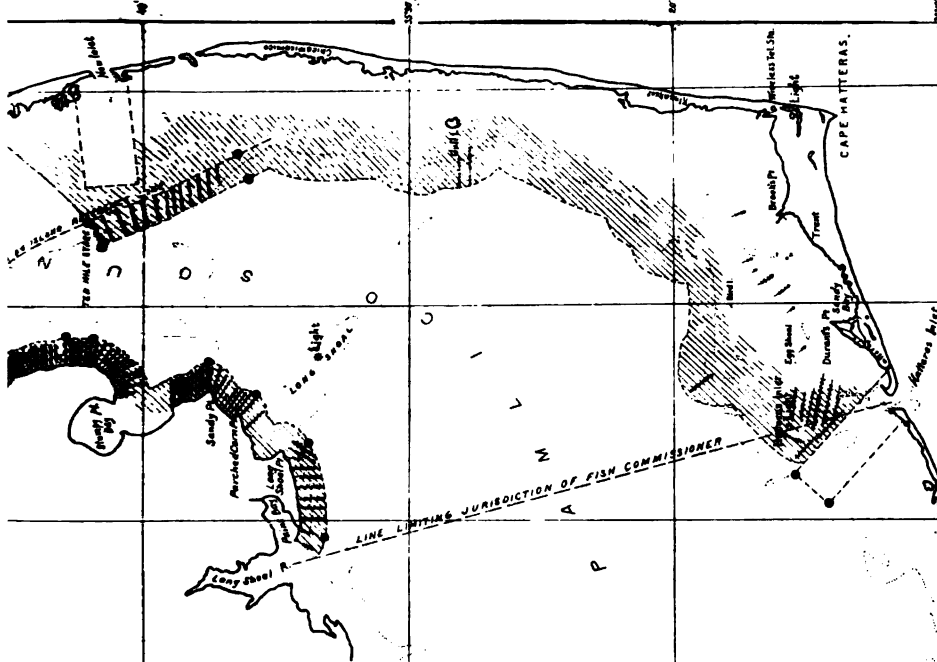
● Position of boundary stakes

--- 12 ft. contour line.



Surveyed and plotted under the direction of T. S. Madril,
Fish Commissioner of North Carolina, by W. P. Hill, C. E.,
Draftsman, Bureau of Fisheries.

MAP
SHOWING LOCATION OF
SEINES AND POUND NETS
FISHED FOR SHAD
IN 1908.
NORTH CAROLINA FISH COMMISSION.



1700

stakes is approximated; while their positions as referred to the actual shore line at present existing may be considered accurately determined.

That Section 2450 of the Revisal of 1905 be repealed because Section 2440 of the Revisal of 1905 includes the territory mentioned in this section and makes the necessary restriction.

Seventh. That Chapter 948 of the Acts of 1907 be amended by striking out the word "Bar" in line two and inserting in lieu thereof the word "mesh." That the word "bar" in line three, Section 2, of said chapter be stricken out.

Eighth. I respectfully call your attention to the act creating the Fish Commission, Chapter 977, Acts 1907, and beg to mention the following changes which, in my judgment, would greatly aid the Commission in the execution of the law and at the same time would enable said Commissioner to furnish such statistics as seems to be necessary for the promotion of said Commission. I recommend that for the purpose of aiding the Commissioner to gather statistics required by him in Section 5 of the Act creating the Commission that the following be added to Section 11 of said Act: "That all persons, firms or corporations securing license to fish under this act, shall keep an account of the number of each kind of fish caught and the price received for same, and on or before July 1, of each year they shall furnish the Fish Commissioner with the total number of each kind of fish caught during the preceding year or such part thereof as he or they may have been engaged as aforesaid. They shall also furnish said Commissioner with such other information as may be required by said Commissioner relative to the number and valuation of boats and other apparatus used and number of men employed. That the Commissioner shall prepare and furnish to each person, firm or corporation so licensed to fish in the State the necessary blanks upon which to make said report. That any person, firm or corporation violating the provisions of this act shall be fined not less than fifty dollars nor thirty days in jail.

I recommend that the following be added to Section 7 of the act creating the Fish Commission: *Provided* that permits to take fish as aforesaid will not be valid unless signed by the Commissioner of the United States Bureau of Fisheries and the Fish Commissioner of the State.

I further recommend and strictly urge that Section 14 of said Act be amended by striking out the remainder of the paragraph after the word "each." Viewing this from a financial standpoint, it would not be advisable, but for the promotion and future development of the Commission, I deem it absolutely necessary.

Ninth. I recommend that the following restrictions be made as to fishing pound-nets on the east side of Roanoke Island. "It shall be un-

lawful to fish with dutch-, pod-, fyke-, or other pound-nets, or nets of like kind, in the waters east of Roanoke Island, and within the following boundaries, viz.: north, from the north line, five miles long, west of Oregon Inlet, mentioned in Section 2440 of the Revisal of 1905 to Mill Creek, except such as shall be fished not to exceed one thousand yards from the eastern shore of Roanoke Island.

The total receipts derived from taxes during the first year of the Commission, from June 1, 1907 to June 1, 1908, is as follows:

Dare County	\$1,597.46
Washington County	187.10
Pasquotank County	45.82
Tyrrell County	174.05
Perquimans County	334.28
Chowan County	897.14
Bertie County	335.20
Sampson County	6.70
Total	\$3,577.75

The expenditures for the year were as follows:

Travelling expenses for Commissioner.....	\$109.82
Travelling expenses for Deputy Commissioner.....	44.60
Office rent	99.97
Stationery	11.90
Office furniture and fixtures.....	89.47
Attorney's fee	10.00
Postage	48.57
Clerk hire	19.25
Inspectors	151.61
Patrol boats, men and expenses of same.....	824.09
Salary of Commissioner and Dept.-Com.....	1,333.33
Survey	718.83
Total	\$3,461.44

During the first year the following number and kinds of nets have been licensed:

County.	Pound-Nets.	Fyke.	Drag-Nets and Seines, yds. of.	Anchor Gill-Nets, yds. of.	Stake Gill-Nets, yds. of.
Dare	1,254	..	1,530	18,700	320,040
Washington	171	20	..	5,402	5,454
Pasquotank	45	60	..	..	20,245
Tyrrell	100	71	..	2,000	53,890
Perquimans	225	5	..	25,200	43,975
Chowan	908	..	..	5,000	20,200
Bertie	251	11	5,280	..	4,700
Sampson	1	4	100	..	1,900
Total	2,955	171	5,910	56,302	479,434

I respectfully call your attention to that part of Section 5 of the Act creating the Commission which requires surveys of the waters where the use of fishing is prohibited and recommend that in making such surveys under said act, the law should designate the distance between stakes or buoys and provide that straight lines be run from stake to stake or buoy to buoy, thereby giving equal opportunity or advantage to all setting between said points.

Finally, I recommend that a law be enacted empowering the Commissioner and his Deputies to remove all nets set in violation of the law, at the expense of the violator, and that all laws in conflict with the above be repealed.

Respectfully,

(Signed) THEO. S. MEEKINS,

Fish Commissioner.

The resolutions adopted by the committee that was appointed by Governor R. B. Glenn, in 1906, to investigate the fishing industries of the State were also presented to the Convention.

All the resolutions presented to the convention and the reports of Mr. Meekins, Fish Commissioner, and Mr. Hill, of the U. S. Bureau of Fisheries, were carefully reviewed and considered by the convention.

RESOLUTIONS ADOPTED BY CONVENTION.

The opinion of the convention regarding what legislation is necessary for the best interests of the fish and oyster industries is expressed in the following resolutions, which refer, first, to the sections of the Code as given in the Revisal of 1905; then to the sections as given in the Public Laws of 1907; and finally, to entirely new legislation.

Resolved, That section

2429. DUTCH-NETS IN PAMLICO RIVER.—It shall be lawful to fish with dutch-, pod-, pyke-, or other pound-nets, or nets of like kind, in the waters of Pamlico River below a line beginning on the southern shore of Pamlico River at Maule's Point, and running due north to a point on the northern shore of said river: *Provided*, that no dutch-, pod-, pyke-, or pound-net, or other nets of like kind, shall extend out in said river more than one-eighth of the distance across said river from the shore, and that none of said dutch-, pod-, pyke-, or pound-nets shall be set, placed down, or fished nearer to each other than five hundred yards, measuring up and down the river; nor shall they be placed, set down, or fished within five hundred yards of any seine-beach in actual use for hauling a seine, nor within one mile of the mouth of Bath Creek: *Provided*, no nets of the kind enumerated in this section, or other nets of like kind, shall be placed down, set, or fished in said rivers between the tenth day of May and the first day of July in any year. Whenever any person shall complain to the Oyster Commissioner or any inspector that dutch-, pod-, or

pyke-nets, or other nets of like kind, have been placed down or set in any of the waters of Pamlico River, or in any of its tributaries, contrary to and in violation of this section, said Oyster Commissioner or inspector, or person performing the duties of such, shall at once visit said river, make a complete and full examination of all dutch-, pod-, or pyke-nets, or other nets of like kinds, in said river, and ascertain whether they are placed down, set, or fished in violation of the provisions of this section, and he shall report to the Solicitor of the district in which the offense is committed.

Code, s. 3417; 1903, c. 52.

be amended so that the words "Oyster Commissioner" shall in each case read "Fish Commissioner" and that all after the word "year" in line 14 (line 16 as printed in the Revisal of 1905) be repealed and the following be inserted in lieu thereof: That any person violating the provisions of this section shall be guilty of a misdemeanor and shall be fined not less than \$50 nor more than \$100 in the discretion of the court.

That section

2432. GAME WARDEN'S RIGHT TO SEARCH VESSELS.—If any constable, game warden or justice of the peace of Currituck County shall be informed, or have cause to suspect, that either of the two preceding sections are being violated, he is hereby authorized and empowered to examine the contents of any fishing-boat, or packages in transit, and any person or common carrier refusing to exhibit the contents of any fishing-boat or package to such officer shall be guilty of a misdemeanor, and shall be fined not less than twenty-five and not more than fifty dollars.

1905, c. 273, ss. 2, 7.

be amended by omitting the word "authorized" in line four and inserting in lieu thereof the word "directed."

That section

2345. DUTCH-NETS IN CARTERET COUNTY.—If any person shall use or cause to be used any dutch-net, pound-net, or other stationary trap, net, or seine of similar description, by whatever name known, in the waters of Carteret County for the purpose of taking fish therefrom, he shall for each day's use thereof forfeit and pay the sum of fifty dollars. The penalties herein created shall be recovered by a warrant before any justice of the peace in the county of Carteret, and shall be applied to the use of the public schools of said county; and such offender, in addition to the penalties contained in this section, shall be guilty of a misdemeanor and fined not less than one hundred dollars nor more than five hundred dollars, or imprisoned in the county jail not less than six months nor more than twelve months: *Provided*, this section shall not apply to the ordinary set-nets heretofore in use in the waters of said county.

Code, s. 3420; 1883, c. 199.

be amended so as to read, "If any person shall use or cause to be used any dutch-net, pound-net, or other stationary trap, net, or seine of similar description, by whatever name known, in the waters of Carteret

County for the purpose of taking fish therefrom, he shall for each day's use thereof forfeit and pay the sum of fifty dollars, excepting from Point of Marsh on south side of Neuse River and running westwardly to Adam's Creek and extending out to a distance of one thousand yards from the shore: *Provided*, that in no case shall the distance the nets extend out into the water be greater than one-eighth of the width of the river: *Provided further*, that the nets shall be one-half mile apart The penalties herein created " to read the same as original section, except that "applied to the use of the public school fund of said county" shall be changed to read, "applied to Fish Commission fund."

That section

2439. DUTCH-NETS IN ALBEMARLE SOUND AND ITS TRIBUTARIES.—No person shall set or fish any dutch-net or pound-net in Roanoke River, Cashie or Middle and Eastmost rivers, or within two miles of the mouth of said rivers, or within one mile of the mouth of any other river emptying into Albemarle Sound, of less than two miles in width at its mouth, and any such net set within one mile of the mouth of any other river emptying into said sound shall not extend into the main channel at its mouth. No person shall set or fish with a dutch-net or pod-net within half a mile to the eastward or westward of the outside windlasses or snatch-blocks of any seine-fishery in operation on said sound; and any such net set or fished within one mile of such windlasses or snatch-blocks of any seine-fishery in operation shall run in a due north and south course from the shore, and shall not extend further into the sound from the water's edge than the distance from such windlass or snatch-blocks to the line of such net; and all persons who shall set or fish any such net in said sound shall pull up and remove the stakes used for the same by the first day of June next succeeding the fishing season, and if any person shall set or fish any dutch-net or pod-net in said sound in violation of this section, he shall be guilty of a misdemeanor, and be subject to a penalty of three hundred dollars, to be recovered by any person in the Superior Court of the county in which the offense shall be committed. And the Sheriff of such county shall, when requested, remove any portion of such nets set or fished in violation of this section at the cost of the violator: *Provided*, that dutch-nets may be used in Cashie River two and one-half miles from its mouth, if they do not extend more than one-third the width of said river from the shore, and such nets may be along the sound shore on the Bertie County side between the following points along said shore, to-wit: commencing at the mouth of Cherry Tree Cut branch, Kentrock field and Landing field, and running around the shore to the mouth of Morgan swamp, thence to Rock Spring branch, and that any nets set or fished within that line shall not extend from the shore in any direction a greater distance than four hundred and fifty yards measured at high water, and within this distance of four hundred and fifty yards is to be included the nets, hedges and all parts thereof.

Code, s. 3383; 1889, c. 122; 1891, c. 322; 1895, c. 245; 1899, c. 310; 1899, c. 412.

be amended as follows: In line 11 (line 13 of the Revisal of 1905) leave out the words "in a due north and south course" and substitute for this; "at right angles to the shore"; in line 15 (line 17 of the Revisal of 1905) leave out the words "remove the stakes used for the same by the first of June next succeeding the fishing season" and insert in lieu thereof; "remove all broken, decayed and abandoned stakes by the first day of May of each year"; and leave out beginning in line 18 (line 21 of the Revisal of 1905) "to be recovered" and ending with "of the violator," line 21 (line 25 of the Revisal of 1905).

That section

2440. DUTCH-NETS IN PAMLICO AND ALBEMARLE SOUNDS.—If any person shall set or fish any net, seine, or appliance of any kind for catching fish at any place within a radius of two and one-half miles either way from Roanoke Marshes lighthouse at a distance more than five hundred yards from the shore of Roanoke Island or the mainland on the western side of Croatan and Pamlico sounds; or shall set or fish any pound- or dutch-net on the eastern side of Pamlico Sound within ten miles of the Roanoke Marshes lighthouse, except such as shall be fished within five hundred yards of the Roanoke Island or Hog Island shores; or shall set or fish any dutch- or pound-net on the eastern side of Pamlico Sound more than two thousand yards west of a line running south-southeast from Big Island to Bulkhead or shoal west of Chicamacomico or south of said point more than two thousand yards from the shoals as marked on the United States Government chart made from data obtained to November twenty-second, one thousand nine hundred and four; or shall set or fish any dutch- or pound-net on the west side of Pamlico Sound in said sound extending into the water more than two thousand yards from the shore of the mainland; or shall set or fish any pound- or dutch-net in Croatan Sound further from the shore than one-fifth the width of said sound at that point; or shall set or fish any pound- or dutch-net in the Albemarle Sound more than two thousand yards from the shore of the mainland, or in Chowan River further from shore than one-third the width of said river at place where said nets are fished or set, or within one-fourth mile of any wharf used by a steamer on said river; or shall set or fish any net or appliance of any kind for catching fish within one mile on north or south side of a line five miles long running west from center of New Inlet or Oregon Inlet, or on north or south side of a line five miles long running northwest from center of Hatteras Inlet, he shall be guilty of a misdemeanor and be fined or imprisoned, in the discretion of the Court. The provisions of this section shall apply only to that part of each year beginning January fifteenth and ending May fifteenth. The place of trial for offenses under this section shall be the county opposite where the act was committed. It shall be the duty of the Oyster Commissioner or Assistant Oyster Commissioner, whenever an affidavit is delivered to him stating that the affiant is informed and believes that this section is being violated at any particular place, to go himself or send a deputy to such place, investigate same, and he shall seize and remove all nets or other appliances setting or being used in viola-

tion of this section, sell same at public auction and apply proceeds of sale to payment of cost and expenses of such removal, and pay any balance remaining to the school fund of county nearest to where offense is committed.

1905, c. 292.

be amended so as to read as follows:

DUTCH- AND OTHER-NETS IN PAMLICO AND ALBEMARLE SOUNDS AND CONTIGUOUS WATERS.—If any person shall set or fish any net, seine or appliance of any kind for catching fish at any place within a radius of two and one-half miles either way from Roanoke Marshes lighthouse at a distance more than five hundred yards from the shore of Roanoke Island or the mainland on the western side of Croatan and Pamlico sounds, *except that on the western side of Pamlico and Croatan sounds fishing shall be permitted in that territory extending one thousand yards from the shore beginning at the two and one-half mile limit heretofore defined and extending to the southern end of the Roanoke Marshes on the Pamlico Sound side and to the north end of the same marshes on the Croatan side, but in neither case shall the nets within this one-thousand-yard limit be within one and one-quarter miles in any direction from the Roanoke Marshes lighthouse*; or shall set or fish any pound- or dutch-net on the eastern side of Pamlico Sound within ten miles of the Roanoke Marshes lighthouse, except such as shall be fished within *one thosusand* yards of the Roanoke Island or Hog Island shores; or shall set or fish any dutch- or pound-net on the eastern side of Pamlico Sound more than two thousand yards west of a line running south-south-east (*magnetic*) from Big Island to a point on the twelve-foot curve *westerly* of Chicamacomico, or south of said point more than two thousand yards from the twelve-foot curve as marked on the chart of the Coast and Geodetic Survey corrected from data obtained to November 22, 1904; or shall set or fish any dutch- or pound-net on the west side of Pamlico Sound in said sound extending into the water more than two thousand yards from the shore of the mainland; or shall set or fish any pound- or dutch-net in Croatan Sound further from the shore than one-fifth of the width of said sound at that point; or shall set or fish any net, seine, or appliance of any kind for catching fish at any place within the area of one-fifth the width of the sound or river on either side of a line passing through the middle of the channel of Croatan Sound and the middle of Albemarle sounds up Chowan River and other tributaries of Albemarle Sound; or shall set or fish any pound- or dutch-net in the Albemarle Sound more than two thousand yards from the shore of the mainland or in Chowan River further from the shore than one-fourth of the width of said river at the place where said nets are fished or set or within one-

fourth mile of any wharf used by a steamer on said river; or shall set or fish any net or appliance of any kind for catching fish within one mile on either side of a line running *westerly or southwesterly from the center of New Inlet to an intersection with the line extending from Big Island southeast (magnetic) or within one mile on either side of a line running westerly or southwesterly from the center of Oregon Inlet to a point two thousand yards west of the continuation of the said line running from Big Island south-southeast (magnetic) or within one mile on either side of a line six miles long running from the center of Hatteras Inlet through and beyond Hatteras Inlet lighthouse, these restricted areas to include the channels extending from Oregon, New, and Hatteras inlets respectively*, he shall be guilty of a misdemeanor and be fined not less than fifty (50) dollars or imprisoned not less than thirty days, in the discretion of the Court. The provisions of this section shall apply only to that part of each year in which *shad and herring fishing are permitted by law in the several waters*; except that in Albemarle and Croatan sounds the provisions of this section shall apply for the entire year as far as it relates to pound-nets. The Fish Commissioner is authorized in determining the boundaries of the restricted areas on either side of Roanoke Marshes to run straight lines from the stake two thousand yards from the shore in the two and one-half-mile radius from Roanoke Marshes lighthouse to the 500-yard stake eastward from the point of Roanoke Marshes, and shall run straight lines from the stake one-fifth the width of Croatan Sound in the two and one-half-mile radius from Roanoke Marshes lighthouse south to the stake 500 yards from the eastward point of Roanoke Marshes; that the boundary lines marking the restricted areas in these sounds shall be run in straight lines from stake to stake located at certain points, but said stakes not to be in any case more than three miles apart. The place of trial for offenses under this section shall be the county opposite where the act was committed.

That section

2448. NET-STAKES REMOVED FROM CERTAIN WATERS.—Every person who shall set or use any net in the waters of Pamlico, Croatan, Currituck, or Albemarle sounds, or their tributaries, except Perquimans River, shall be required to pull up and remove their net-stakes within thirty days from the day the nets were taken from them, and not later than the first day of June, and any person failing to pull up and remove their stakes, as required by this section, shall be guilty of a misdemeanor, and fined not more than fifty dollars or imprisoned not more than thirty days.

Code, ss. 3382, 3414; 1883, c. 69; R. C., c. 81, s. 8; 1844, c. 40, s. 7; 1852, c. 13; 1893, c. 147.

be amended as follows; "and remove their net-stakes within thirty days from the day the nets were taken from them, and not later than the first

day of June," to read "and remove all broken, decayed, and abandoned stakes by the first day of May of each year."

That section

2450. DUTCH-NETS AT THE INLETS.—If any person shall set any pound-net, dutch-net, or hedge-net within two miles of Oregon Inlet or Hatteras Inlet or within ten miles of New Inlet in Dare County, North Carolina, or shall between the first day of January and the first day of May following of any year, set or operate any seine or stationary nets of any kind in the main channels within three miles of the inside mouths of Ocracoke, Hatteras, Oregon, or any other inlet north of Ocracoke Inlet, connecting the waters of the Atlantic Ocean with any of the sounds or other inland waters of North Carolina, or shall fish with seines or nets of any description in the waters of Bear Inlet or Brown's Inlet or within one mile of Bear Inlet or Brown's Inlet, on the eastern or western beach of said inlets, except at regularly established fisheries on said Bear or Brown's Inlet beaches, or shall fish with seines or nets on the inside of said Bear or Brown's Inlet within one-fourth mile of said inlets between the first day of October and the first day of April, he shall be guilty of a misdemeanor.

1893, c. 216; 1903, c. 724; 1903, c. 416.

be amended by leaving out beginning with "person" in line one and ending with "North Carolina," line three (line 4 Revisal of 1905), and substituting in lieu thereof: "Shall set or fish any net or appliance of any kind for catching fish within one mile on either side to a line running westerly or southwesterly from the center of New Inlet to an intersection with the line extending from Big Island southeast (magnetic) or within one mile on either side of a line running westerly or southwesterly from the center of Oregon Inlet to a point two thousand yards west of the continuation of the said line running from Big Island south-southeast (magnetic) or within one mile on either side of a line six miles long running from the center of Hatteras Inlet through and beyond Hatteras Inlet Lighthouse, these restricted areas to include the channels extending from Oregon, New and Hatteras Inlets, respectively."

That Sections 2424, 2428, 2433 and 2452 be repealed for the reason that all the restrictions in these four sections are embodied in other sections of the Revisal for 1905.

LAWS OF 1907.—That Chapter 948

AN ACT TO REGULATE FISHING IN THE WATERS OF PAMLICO, TAR, NEUSE AND CAPE FEAR RIVERS, PAMLICO SOUND AND WATERS IN CARTERET COUNTY.—Section 1. That there shall be no pound- or other tarred-nets with a mesh smaller than one and one-half inches bar, before tarring, fished in Pamlico, Tar, and Neuse Rivers, Pamlico Sound and the waters of Carteret County, and there shall be no pound- or stake-nets fished within three miles of the inside mouths of Ocracoke Inlet nor in the principal channel or channels of said inlet nor within one mile of said channel or channels until the said

channel or channels reach deep water, at any time, and the other inlets north of it shall be left under the Vann Bill, chapter two hundred and ninety-two, Laws of one thousand nine hundred and five.

Sec. 2. No stake- or pound-net which shall be fished in any of the waters mentioned in this act, without being tarred, shall have a mesh of less than one and three-eighths inches bar.

Sec. 3. That the bunt of all seines and haul-nets fished in the waters of Pamlico, Tar, and Neuse rivers and Pamlico Sound shall not be smaller than one and one-eighth inches bar net; *Provided*, this bunt shall not be longer than thirty yards; *Provided*, that nothing herein shall apply to nets fishing for menhaden.

Sec. 4. Any person violating any of the provisions of this act shall be guilty of a misdemeanor, and shall be fined not less than one hundred dollars and imprisoned at the discretion of the Court.

Sec. 5. That this act shall be in effect from and after January first, one thousand nine hundred and eight.

be amended by adding to Section 4: "*Provided*, that this chapter shall only apply to that part of the year beginning January 15 and ending May 15."

That in Chapter 977

AN ACT TO CREATE A FISH COMMISSIONER.—Section 7. *Power to Take Fish.* The Fish Commissioner and the United States Bureau of Fisheries may take and cause to be taken for scientific purposes, or for fish culture, any fish or other marine organism at any time from the waters of North Carolina, any law to the contrary notwithstanding.

shall be amended by adding to the clause of the section: "*Provided*, that permits to take fish as aforesaid will not be valid unless signed by the Commissioner of the U. S. Bureau of Fisheries and the Fish Commissioner of the State."

That Section

11 of Chapter 977, *License to fish*, be amended by adding to the clause of the section; "That all persons, firms or corporations securing license to fish under this act shall keep an account of the number of each kind of fish caught and the price received for same and on or before July 1 of each year, they shall furnish the Fish Commissioner with the total number of each kind of fish caught during the preceding year, or such part thereof as he or they have been engaged as aforesaid; they shall also furnish said Commissioner with such other information as may be required by said Commissioner relative to the number and value of boats or other apparatus used and number of men employed; that the Commissioner shall prepare and furnish to each person, firm or corporation so licensed to fish in the State the necessary blanks upon which to make said report."

That section

14 of Chapter 977, *License Tax*. The following license tax is hereby levied upon the different fishing appliances used in the waters of North Carolina: Anchor gill-nets, ten cents per one hundred yards or fraction thereof; stake gill-nets, ten cents per one hundred yards or fraction thereof; drift gill-nets, ten cents per one hundred yards or fraction thereof; pound-nets, one dollar each; seine and drag-nets over three hundred yards and under one thousand yards, one dollar and twenty-five cents per one hundred yards or fraction thereof; seine and drag-nets over one thousand yards, one dollar and seventy-five cents per one hundred yards or fraction thereof; fyke-nets, twenty-five cents each: *Provided*, this act shall not apply to the counties of Currituck, Camden, Carteret, Hyde, New Hanover, Craven, Onslow, Brunswick, Pender, Pamlico and Beaufort.

be amended by inserting in line seven after "drag-nets" the following: "Under 100 yards, \$1.00 each; seine and drag-nets over 100 yards and under 300 yards, \$1.00 per hundred yards or fraction thereof"; and in line 10 after "each" insert the following: "minor-nets, 20 cents each."

NEW GENERAL LEGISLATION RECOMMENDED.

SECTION EARLY CLOSING SEASON FOR SHAD AND ALEWIFE OR HERRING.—All shad apparatus on the Cape Fear River below the mouth of Black River shall be taken out of the river by April first, and all above this point shall be taken out by April tenth; in Northeast Cape Fear River below Castle Hayne, all shad apparatus shall be taken out by April tenth, and all above that point by April twentieth; in the Black and other tributaries of the Cape Fear River all shad apparatus shall be taken out by April twentieth; in the Neuse River all gill-nets used for shad and alewife fishing shall be taken out of the river by April tenth; but all other shad and alewife apparatus in the Neuse River at or below the town of New Berne shall be taken out by May first, and all above that town by May tenth; in Pamlico and Pungo rivers, all gill-nets operated for shad and alewife fishing shall be taken out by April thirteenth, and all other alewife and shad apparatus shall be taken out by May first; in Tar River all shad and alewife apparatus shall be taken out of the river by May tenth; in Pamlico, Roanoke, Croatan, and Albemarle sounds east of Perquimans River on the north and Ship Point on the south (this to apply to the tributaries of the sound in this section), all gill-nets shall be taken out by April 13, and all other shad and alewife apparatus shall be taken out by May first, and in that portion of the Albemarle Sound west of the above points as far as Horney Blow Point on the north and Mackey's Creek on the south, all gill-nets shall be taken out by April eighteenth, and all other shad and alewife apparatus shall be taken

out by May twelfth; thence west as far as the mouth of Chowan River, all gill-nets operated for shad and alewife fishing shall be taken out by April eighteenth, and all other shad and alewife apparatus shall be taken out by May twelfth, these dates to apply to the tributaries of this section of Albemarle Sound; in Chowan River all shad and alewife apparatus shall be taken out of the river by May fifteenth. If any person shall set or fish any net wilfully in violation of this section, he shall be guilty of a misdemeanor and fined not less than fifty dollars: *Provided*, that all pound-nets in any part of the waters mentioned in this section that are cut down in order to rid them of moss are to be considered as fulfilling the law.

SECTION DOUBLE SEINING.—All double seining in any of the waters or rivers of the State, and the hauling or drawing two seines in succession over the same bottom or within four hundred yards of that bottom is hereby prohibited; *Provided*, that the four-hundred-yard limit of this chapter does not apply to any place where conditions are such that the tide or current would occasionally carry one seine across a portion of the bottom that is being hauled by another seine; and any person violating this chapter shall for each violation be fined not less than two hundred and fifty dollars nor more than five hundred dollars.

SECTION PROTECTION OF STURGEON.—No person shall set or fish any sturgeon-net in the inland waters of North Carolina for a period of five years from the date of the passage of this act, and all sturgeons less than five feet long caught in any other manner whatever shall be returned to the water alive, and any person violating this section shall be guilty of a misdemeanor and fined not less than fifty dollars or imprisoned not less than twenty days; and the possession of any sturgeon less than five feet in length shall be *prima facie* evidence that the person having the same is violating this section. For the purposes of this act inland waters are defined as all waters of the State lying within the ocean inlets and the mouths of rivers and bays opening directly into the sea.

SECTION ROCKFISH.—If any person shall offer for sale any rockfish weighing less than one-half pound, he shall be guilty of a misdemeanor and be fined ten dollars for every offense.

SECTION PURSE-NET.—No person shall use or fish a purse-net for rockfish or perch in any of the waters in North Carolina, except in the open sea, and any person offending against this section shall be fined not less than fifty dollars for each offense.

SECTION SHAD AND HERRING.—Any person who shall catch or cause to be caught any shad or herring in the waters of the State of North Carolina for any other purpose than as food shall be guilty of

a misdemeanor and fined not less than fifty dollars or imprisoned not less than thirty days.

SECTION FISHING ON SUNDAY.—If any person shall fish, haul, set, draw, or place in the water for fishing purposes, any net from midnight of Saturday night to midnight of Sunday night, he shall be guilty of a misdemeanor and fined not less than twenty-five dollars for each and every offense.

SECTION POUND-NETS ON EAST SIDE OF ROANOKE ISLAND.—It shall be unlawful to fish with Dutch,- pod,- fyke- or other pound-nets or nets of like kind in the waters east of Roanoke Island within the following boundaries: North from the north line five miles long west from Oregon Inlet mentioned in Section 2440 of the Revisal of 1905 to Mill Creek, except such as shall be fished not to exceed one thousand yards from the eastern shore of Roanoke Island.

SECTION CLOSED SEASON FOR FRESH-WATER FISH.—That if any person shall take or catch any fresh-water fish with any kind of net in the waters of North Carolina lying to the east of the 78th meridian of longitude from the first day of May to the first day of August of each year, he shall be guilty of a misdemeanor; *Provided*, that this does not prohibit the catching of fish with hook and line.

SECTION REMOVAL OF NETS.—The Fish Commissioner and his deputies are hereby empowered to remove any and all nets set in violation of any law and at the expense of the violator, all such laws to the contrary notwithstanding.

SECTION FINES.—That all fines, by whomsoever collected, penalties for violation of laws relating to fin fishing, shall be deposited in the State Treasury to the credit of the Fish Commission fund.

RESOLUTIONS RELATING TO THE TERRAPIN.

That Section 2370 of the Revisal of 1905

DIAMOND-BACK TERRAPIN. PROTECTED.—If any person shall take or catch any diamond-back terrapin between the fifteenth day of April and the fifteenth day of August of any year, or any diamond-back terrapin at any time, of less size than five inches in length upon the bottom shell, or shall interfere with or in any manner destroy any eggs of the diamond-back terrapin, he shall be guilty of a misdemeanor, and shall be fined not less than five dollars nor more than ten dollars for each and every diamond-back terrapin so taken or caught, and a like sum for each and every egg interfered with or destroyed: *Provided*, this section shall not apply to parties empowered by the State to propagate the said diamond-back terrapin; and the possession of any diamond-back terrapin between the fifteenth days of April and August shall be *prima facie* evidence that the person having the same

has violated this section. It shall be the duty of all sheriffs and constables to give immediate information to some justice of the peace of any violation of this section.

Code, s. 3377; 1899, c. 582; 1881, c. 115, ss. 1, 6.

be changed so that it will read as follows:

If any person shall take or catch or have in his possession any diamond-back terrapin between the first day of March and the thirty-first day of August of any year, or any diamond-back terrapin at any time, of less size than five inches in length upon the bottom shell, or shall interfere with, or in any manner destroy any eggs of the diamond-back terrapin, he shall be guilty of a misdemeanor, and shall be fined not less than five dollars, nor more than ten dollars, for each and every diamond-back terrapin so taken or caught, and a like sum for each and every egg interfered with or destroyed: *Provided*, that this section shall not apply to parties empowered by the State to propagate the said diamond-back terrapin; and the possession of any diamond-back terrapin between the first day of April and thirty-first day of August shall be *prima facie* evidence that the person having the same has violated this section: *Provided further*, that the provisions of this act shall apply to any person, firm, or corporation receiving or having for transportation undersized terrapins, or during the closed season terrapins of any size whatever. It shall be the duty of all sheriffs and constables to give immediate information to some justice of the peace of any violation of this section.

RESOLUTIONS RELATING TO THE OYSTER INDUSTRY.

That Section 2371 of the Revisal of 1905

NATURAL, DEFINED.—A natural oyster or clam bed, as distinguished from an artificial oyster or clam bed, shall be one not planted by man, and is any shoal, reef, or bottom where oysters are to be found growing in sufficient quantities to be valuable to the public.

1893, c. 287, s. 1.

be amended so as to read as follows:

In the waters of North Carolina a natural oyster reef or bottom shall be considered and defined as an area containing not less than a continuous area of one acre of the bottom on which oysters are found growing natural at the time or have been so found during a period of five years preceding the time at which the decision be made and in sufficient quantities to make their fishing profitable by means of hand-tongs on such ground as are reserved exclusively for tonging, or dredges on such beds as are designated for dredging: *Provided*, that no intervals of less than one hundred yards shall be considered as breaking the continuity of the bed.

That section

2393. OYSTERS, WHERE PURCHASED TO BE CARRIED OUT OF THE STATE.—If any person shall purchase and load on a vessel or boat any oysters to be carried out of the State in the shell, except at the following places, to-wit, the south end of Roanoke Island, Stumpy Point Bay, Parched Corn Bay, Wysocking Bay, West Bluff Bay, Great Island Narrows, or Swan Quarter Bay (as the Oyster Commissioner may determine), Portsmouth, Ocracoke, Bay River, mouth of Rose Bay, or Harbor Island; or if any person shall load more than one boat or vessel at any of said places at one and the same time, or if any person shall load any boat or vessel with oysters to be carried out of the State without such vessel having an inspector on board at the time the oysters are delivered, or shall carry any vessel loaded or partly loaded with oysters through the canals without a certificate showing that the oysters have been inspected and the taxes thereon paid, he shall be guilty of a misdemeanor, and be fined not more than fifty dollars or imprisoned not more than thirty days.

1903, c. 516, s. 17.

be repealed and the following substituted for it:

Any corporation domiciled in this State with their factories, shucking plants, and shipping depots located in this State, may enjoy the rights of fishing oysters from the natural reefs and of bedding oysters on leased bedding grounds: *Provided*, such oysters are canned, shucked, or packed in this State, or shipped raw in shells from a shipping depot in this State for consumption either in or out of this State; but no person, firm, or corporation shall ship oysters out of this State for canning or packing out of this State. As it is the desire of the State to encourage the planting of shells on barren bottoms in this State, no oysters in shell shall be shipped out of this State without the shipper first obtains from the Shell-fish Commissioner of North Carolina permit so to do, and for which no charge shall be made by said Commissioner.

That sections

2401. LARCENY OF OYSTERS ON PRIVATE BEDS.—Any person who shall feloniously take, catch, or capture or carry away any shell-fish from the bed or ground of another, shall be guilty of larceny and punished accordingly.

1887, c. 119, s. 15.

and

2402. OYSTERS CAUGHT AT NIGHT; INJURY TO PRIVATE BEDS.—If any person shall wilfully commit any trespass or injury with any instrument or implement upon any ground upon which shell-fish are being raised or cultivated, or shall remove, destroy, or deface any mark or monument lawfully set up for the purpose of marking any grounds, or who shall work on any oyster-ground at night, he shall be guilty of a misdemeanor. But nothing in the provisions of this section shall be construed as authorizing interference with the capture of migratory fishes or free navigation or the right to use on any

private grounds any method or implement for the taking, growing, or cultivation of shell-fish.

1887, c. 119, s. 11.

be repealed and the following substituted for them:

SECTION Any person who shall wilfully and without authority take or remove oysters from any land leased under the laws of the State of North Carolina, or shall wilfully injure or interfere with the oysters of such land in any manner, or injure oysters thereupon situated, or wilfully remove, alter, or interfere with the stakes, buoys, or monuments marking the same, shall, upon conviction thereof, for the first offense be sentenced to imprisonment in jail or in the penitentiary, in the discretion of the Court, for not less than three months and not more than two years, and for the second or any subsequent offense be sentenced to imprisonment in the penitentiary for not less than two years and not more than five years.

SECTION Any person who shall work a dredge, scrape, or pair of tongs or any other implement for the taking of oysters upon any land leased under the provisions of this act, without the consent of the lessee or owner, or who shall, while upon or sailing over any such ground or bed, cast, haul, or have overboard any such dredge, scrape, or pair of tongs or other implement for the taking of oysters under any pretense or for any purpose whatever, without the consent of such lessee or owner, upon conviction thereof shall for the first offense be fined not less than fifty dollars nor more than two hundred and fifty dollars or, in the discretion of the Court, be imprisoned in the jail.

That Section 2415 of the Revisal of 1905, which was amended in 1907 by striking out the words "two and a half" in lines three and four and inserting in lieu thereof "three" and by striking out the words "from hinge to mouth" in line four and inserting in lieu thereof "in longest diameter" is hereby amended by leaving out the amendment of 1907 and re-inserting the former words.

That Sections 2373, 2375, 2376, 2378, 2379, 2380 and 2426 are hereby repealed.

GENERAL OYSTER LAWS RECOMMENDED.

The convention adopted a resolution regarding the reorganization of the Shell-fish Commission.

The convention were of the opinion that a Shell-fish Commission should be established and inaugurated by the Legislature on similar lines as those relating to the formation of the Fish Commission; believing that if legislation is obtained regarding the cultivation of the oyster and the

leasing of bottoms for that purpose, it will require the Shell-fish Commissioner and the Deputy Commissioner to devote all their time to the carrying out of the duties of their office, and it recommends the following:

1. NORTH CAROLINA SHELL-FISH COMMISSION.—The Shell-fish Commission shall, except as in this act otherwise provided, consist of a single Commissioner. He shall be appointed by the Governor by and with the advice and consent of the Senate within thirty days after the passage of this act. He shall be responsible for the carrying out of the duties of his office to the Geological and Economic Survey Board, and shall make semi-annual reports to them. The term of office of such Commissioner and his successors in office shall be four years or until their successors are appointed and qualified, and in case of vacancy in the office, the appointment shall be to fill the vacancy. The said Commissioner shall appoint a Deputy Commissioner, who, during the absence or inability to act of the Commissioner, shall have and exercise all of the powers of the Commissioner. The Shell-fish Commissioner and Deputy Commissioner shall each execute and file with the Secretary of State bonds in the sum of seven thousand and five thousand dollars, respectively, with sureties to be approved by the Secretary of State, conditioned for the faithful performance of their duties and to account for and pay over, pursuant to law, all moneys received by them in their office. The Shell-fish Commissioner shall take and subscribe an oath to support the Constitution and for the faithful performance of the duties of his office, which oath shall be filed with the bond. The Deputy Commissioner may be removed from his office for cause by the Commissioner, who may appoint his successor.

INSPECTORS, HOW APPOINTED; TERM, SALARY, BOND, OATH OF OFFICE.—The Shell-fish Commissioner shall appoint, from the counties within which they are to perform their duties, a sufficient number of inspectors, who shall serve during the oyster season, and may remove them for cause. He shall fix the compensation of the inspectors at not exceeding fifty dollars a month while on duty, and shall designate the length of service, the time when the inspectors go on duty and when they go off. The inspectors shall give bond in the sum of five hundred dollars, payable to the State of North Carolina, conditioned for the performance of the duties of their office, and the faithful accounting for all moneys received, which bond shall have at least two sufficient sureties, to be justified before, approved by, and filed with the Clerk of the Superior Court of the county where they reside, and shall take, subscribe, and file with such Clerk an oath of office. They shall be paid only for the time they serve.

OFFICE AND CLERICAL FORCE.—The Commissioner shall have an office in some town conveniently located to the oyster-beds of the State, and he is authorized to employ such clerks as may be necessary for the proper carrying on of the work of his office.

EQUIPMENT.—The Shell-fish Commissioner is authorized, by and with the consent of the Geological and Economic Survey Board, to purchase or rent such boats, dredges, and other equipment as may be necessary to enable him and his deputies to carry out the duties of his office as specified in this act.

DUTIES OF THE SHELL-FISH COMMISSIONER.—The Shell-fish Commissioner shall have a general supervision over every branch of the shell-fish industry, including the oyster, clam, scallop, and other mollusca, and see that the laws regulating the same are rigidly enforced. He shall collect and compile statistics showing the annual product of the oysters, clams, and other mollusca that are taken out of the waters of the State, and the capital invested and the apparatus employed; he shall have surveyed and marked in a prominent manner those areas of bottoms in the waters of the State in which oyster-tonging or dredging is prohibited by law, or those areas which are leased for the purpose of the cultivation of oysters or clams; he shall be responsible for the collection of all license fees, taxes, fines, or other imposts upon any of the shell-fish fisheries, and shall receive all fines imposed for the infraction of the shell-fish laws, and shall collect all rentals for bottoms leased for oyster or clam cultivation, and shall pay same into the State Treasury to the credit of the Shell-fish Commission fund to be drawn upon as directed by the Geological and Economic Survey Board; he shall see that the laws regulating the catching and handling of oysters, clams, and other mollusca are enforced; that no illegal methods are used in catching, selling, or shipping; that the cull law is rigidly enforced, and that only proper and legal methods are used in buying and selling. He shall prosecute all violations of the law, and whenever it is necessary he may employ counsel for this purpose. He shall in his official capacity have power to administer oaths and to send for and examine persons and papers; he shall, on or before the twenty-fifth day of each month, mail to the Treasurer of the State a consolidated statement showing the amount of taxes collected during the preceding month, and by and from whom collected. He shall make a semi-annual report to the Geological and Economic Survey Board, setting forth in detail an account of his official acts, the condition of the oyster and other shell-fish industries in all their branches, and shall recommend such additions to or modifications of existing laws relating thereto as he may deem proper and necessary.

ARRESTS WITHOUT WARRANT, WHEN AND HOW MADE.—The Shell-fish Commissioner, Deputy Commissioner, and inspectors shall have power, with or without warrants, to arrest any person violating the fishery laws.

POWER TO TAKE OYSTERS AND CLAMS.—The Shell-fish Commissioner and the United States Bureau of Fisheries may take and cause to be taken for scientific purposes any oysters, clam, or other mollusca at any time from the waters of the State, any law to the contrary notwithstanding; *Provided* that the permits issued shall be signed by the Commissioner of the U. S. Bureau of Fisheries and the North Carolina Shell-fish Commissioner.

SALARIES.—The salary of the Shell-fish Commissioner shall be fifteen hundred dollars per year and the expenses necessarily incurred by him in the discharge of his duties. The salary of the Deputy Shell-fish Commissioner shall be nine hundred dollars per year and the expenses necessarily incurred by him in the discharge of his duties. The salaries of clerks and of scientific assistants which may be employed from time to time are to be fixed by the Geological and Economic Survey Board.

NO INTEREST IN OYSTER, CLAM, OR OTHER MOLLUSCA FISHERIES.—The Shell-fish Commissioner, Deputy Commissioner, and inspectors shall not be interested in any oyster, clam, or other mollusca fishing industry in North Carolina.

REVENUE.—All license fees, taxes, rentals of oyster and clam bottoms, fines or other imposts upon the oyster, clam, scallop, and other mollusca fisheries, or fines imposed for infraction of the oyster, clam, and other mollusca fishery laws, in whatever manner collected, shall be paid to the State Treasurer to the credit of the Shell-fish Commission fund, to be drawn upon as directed by the Geological and Economic Survey Board, and shall constitute the revenue of the Shell-fish Commission.

If the organization of a Shell-fish Commission as outlined above is incorporated, then Sections 2398, 2403, 2404, 2405, 2406, 2407, 2422, which are given beyond, should be repealed.

CULTIVATION OF THE OYSTER AND CLAM.

The following legislation is urgently recommended by the convention as being the most practical for encouraging and stimulating oyster and clam culture in North Carolina and as being the best means for building up and increasing the productivity of the natural oyster beds.

CHAPTER

SECTION 1. SHELL-FISH COMMISSIONER CAN LEASE BOTTOMS.—The Shell-fish Commissioner shall have power to lease to any duly qualified person, firm, or corporation, for purposes of oyster or clam culture, any

bottom of the waters of the State not a natural oyster-bed as defined in this act, nor a clam reservation as defined in this act, in accordance with the provisions of this law.

SEC. 2. LEASING OF BOTTOMS.—Any citizen of North Carolina or firm or corporation organized under the laws of the State and doing business within its limits shall be granted the privilege of taking up bottoms for purposes of oyster or clam culture under the provisions of this act of an area not less than one acre nor more than fifty acres, with the exception of the open waters of Pamlico Sound (and for the purposes of this act open waters of Pamlico Sound shall mean the waters that are outside of two miles of the shore line), in which the minimum limit shall be five acres and the maximum shall be two hundred acres: *Provided*, that the limit of entry in Core Sound, North River, Newport River, Bogue Sound, and all bays and creeks bordering on these waters, and in Jones Bay, Rose Bay, Abels Bay, Swan Quarter Bay, Middle Bay, Bay River, Deep Bay, Juniper Bay, West and East Bluff Bays, Wysocking Bay, Fire Creek, Stumpy Point Bay, Mouse Harbor Bay, Maw Bay, and Broad Creek tributaries of Pamlico Sound, shall be one acre as a minimum and ten acres as a maximum: *Provided further*, however, that at the end of one year from the passage of this act that the minimum area in Core Sound, North River, Newport River, Bogue Sound, and all bays and creeks bordering on these waters, and in Jones Bay, Rose Bay, Abels Bay, Swan Quarter Bay, Middle Bay, Bay River, Deep Bay, Juniper Bay, West and East Bluff Bays, Wysocking Bay, Fire Creek, Stumpy Point, Mouse Harbor Bay, and Maw Bay, and Broad Creek tributaries of Pamlico Sound, shall be one acre and the maximum fifty acres; but no person, firm, corporation, or association shall severally or collectively hold any interest in any lease or leases aggregating an area of greater than fifty acres, except in the open waters of Pamlico Sound, where the aggregate area shall be two hundred acres.

SEC. 3. LEASE, HOW OBTAINED.—Such persons, firms, or corporations desiring to avail themselves of the privileges of this act shall make written application on a form to be prepared by the Shell-fish Commissioner, setting forth the name and address of the applicant, describing as definitely as may be the location and extent of the bottom for which application is made, and requesting the survey and leasing to the applicant of said bottom. As soon as possible after the application is received the Shell-fish Commissioner shall cause to be made a survey and map of said bottom at the expense of the applicant. The Shell-fish Commissioner shall also thoroughly examine said bottoms by sounding and by dragging thereover a chain to detect the presence of natural oysters. Should any

natural oysters be found, the Commissioner shall cause examination to be made to ascertain the area and density of oysters on said bottom or bed to determine whether the same is a natural bed under the definition contained in this act. He shall be assisted in this examination on tonging ground by an expert tonger to be appointed by the Board of County Commissioners of the county in which said bottom or the greater portion thereof is located, and the question as to whether the oyster growth is sufficiently dense to fall within the definition of the natural bed shall be determined by the quantity of oysters which the said expert tonger may be able to take in a specified time; and on dredging-ground the Commissioner shall be assisted by an expert dredger, appointed by the Board of County Commissioners of the county in which said bottom or the greater portion thereof is located, and the question as to whether the oyster growth is sufficiently dense to fall within the definition of the natural bed shall be determined by the quantity of oysters which the said expert dredger may be able to take in a specified time. The Shell-fish Commissioner shall require the bodies of bottoms applied for to be as compact as possible, taking into consideration the shape of the body of water and the consistency of the bottom. No application shall be entertained nor lease granted for a piece of bottom within two hundred yards of a known natural bottom, bed, or reef. A deposit of ten dollars will be required of each applicant at the time of making his application, said sum to be credited to the cost of the survey of the bottom applied for.

SEC. 4. MARKING AND STAKING OF LEASED BOTTOMS.—Immediately upon the completion of the survey and the mapping thereof and the payment by the applicant of the cost of said survey and map, the Shell-fish Commissioner shall execute to the applicant, upon a form approved by the Attorney-General of the State, a lease for the bottoms applied for. A copy of the lease, map of the survey, and a description of the bottom, defining its position, shall be filed in the office of the Shell-fish Commissioner. After the execution of said lease, the lessee shall have the sole right and use of said bottoms, and all shells, oysters, and cultch thereon, or placed thereon, shall be his exclusive property so long as he complies with the provisions of this law. The lessee shall stake off and mark the bottoms leased in the manner prescribed by the Shell-fish Commissioner, and failure to do so within a period of thirty days of an order so to do issued by the Commissioner shall subject said lessee to a fine of five dollars per acre for each sixty days' default in compliance with said order. The corner stakes, at least, of each lease shall be marked with signs plainly displaying the number of the lease and the name of the lessee. The lessee shall within two years of the commencement of his

lease have planted upon his holdings a quantity of shells equal to an average of fifty bushels of seed oysters or shells per acre of holdings, and within four years from the commencement of his lease, a quantity of oysters or shells equal to an average of not less than one hundred and twenty-five bushels per acre. The Oyster Commissioner shall, upon granting any lease, publish a notice of the granting of same in a newspaper of general circulation in the county wherein the bottom leased is located.

SEC. 5. TERM OF LEASE, RENTAL.—All leases made under the provisions of this act shall begin upon the issuance of the lease and shall expire on the first day of April of the twentieth year thereafter. The rental shall be at the rate of one dollar per acre per year for the first ten years and two dollars per acre per year for the next ten years of the lease, payable annually in advance on the first day of April of each year: *Provided*, that in the open waters of Pamlico Sound—and for the purposes of this act the open waters of Pamlico Sound shall mean the waters that are outside the two miles of the shore line—the rental shall be at the rate of fifty cents per acre per year for the first three years; one dollar per acre per year for the next seven years; and two dollars per acre per year for the next ten years of the lease. This rental shall be in lieu of all other taxes and imposts whatever and shall be considered as all and the only taxation which can be imposed by the State, counties, municipalities, or other subordinate political bodies. The rental for the first year shall be paid in advance to an amount proportional to the unexpired part of the year to the first of April next succeeding.

SEC. 6. TRANSFER OF LEASE, INHERITANCE OF LEASE.—The said lease shall be heritable and transferable, in whole or in part, provided the qualifications of the heirs and transferees are such as are described by this act. Non-residents, acquiring by inheritance or process sale, or persons already holding the maximum area permitted by this act, shall within a period of twelve months from time of acquisition dispose of said prohibited or excess of holding to some qualified person, firm, or corporation, under penalty of forfeiture. The lease shall be subject to mortgage, pledge, seizure for debt, and the same other transactions as are other property rights in North Carolina. No transfer shall be of effect, unless of court record, until entered on the books of the Shell-fish Commissioner.

SEC. 7. RE-LEASING OF BOTTOMS.—The term of each lease granted under the provision of this act shall be for a period of twenty years from the first day of April preceding the date of granting of said lease. At the expiration of the first lease the lessee, upon making written application on the prescribed form, shall be entitled to successive leases on the same terms as applied to the last ten years of the first lease, for a period not exceeding ten years each.

SEC. 8. FORFEITURE OF LEASE.—The failure to pay the rental of bottoms leased for each year in advance on or before the first day of April or within thirty days thereafter shall *ipso facto* cancel said lease and shall forfeit to the State the said leased bottoms and all oysters thereon, and upon said forfeiture the Shell-fish Commissioner is hereby authorized to lease the said bottoms to any qualified applicant therefor: *Provided*, that no forfeiture shall be valid, however, under the provisions of this section, unless there shall have been mailed by the Shell-fish Commissioner to the last address of the lessee upon the books of the Commissioner a thirty days' notice of the maturity of said rental.

SEC. 9. TITLE SECURE.—If any person within four months of the publication of the notice of granting of any lease make claim that a natural oyster bottom, bed, or reef exists within the boundaries of said lease, he shall under oath state his claim and request the Shell-fish Commissioner to cancel said lease: *Provided, however*, that each such claim and petition shall be accompanied by a deposit of twenty-five dollars. No petition unaccompanied by said deposit shall be considered by the Commissioner. The Shell-fish Commissioner shall in person examine into said claim, and, if the decision should be against the claimant, the deposit of twenty-five dollars shall be forfeited to the State and deposited to the credit of the Shell-fish Commission fund. Should, however, the claim be sustained and a natural bed be found within the boundary of the lease, the said natural bed shall be surveyed and marked with stakes or buoys at the expense of the lessee, and the said natural bed be thrown open to the public fishery. If no such claim be presented within a period of four months, or if when so presented it fail of substantiation as provided, the lessee shall thereafter be secure from attack on such account and his lease shall be incontestable so long as he complies with the other provisions of this act. In each and every such case the decision of the Shell-fish Commissioner shall be subject to review and appeal before a Judge of the Superior Court, who shall render a decision without the aid of a jury, and his decision shall be final.

SEC. 10.—That all laws and clauses of laws in so far as they are in conflict with this act are hereby repealed.

The laws that should be repealed, if the above chapter is passed, are Sections 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380 and 2382.

CHAPTER

SECTION 1.—That the Oyster Commissioner is hereby authorized to employ collectors at the smaller places to collect the oyster tax on a commission basis, the amount of the commission to be determined at the discretion of the Oyster Commissioner; *Provided*, that at least 10 per

cent and not over 40 per cent of the amount collected can be allowed the collector.

SEC. 2.—The State of North Carolina shall exercise exclusive jurisdiction and control over all the shell-fisheries of the State wherever located, whether these fisheries be for oysters, clams, scallops, or any other mollusca whatever.

SEC. 3. DELIVERY OF OYSTERS WITHOUT INSPECTION.—If any boatman shall deliver oysters to any one before they have been inspected by the inspector, he shall be guilty of a misdemeanor, and fined not less than fifty dollars: *Provided*, that in case the boatman is unable to find the inspector, he (the boatman) can deliver the oysters and report to the inspector afterwards, but within forty-eight hours of delivery of oysters.

SEC. 4.—All these acts relating to the fish, oyster, and clam are to be effective as soon as they have been ratified.

SPECIAL RESOLUTIONS PASSED BY THE CONVENTION.

WHEREAS, That the fish and oyster industries of North Carolina are of very great importance and value to the State; and

WHEREAS, There has been a general decline in the value of these industries for the past few years; and

WHEREAS, It is believed that by proper legislation these industries can be built up and brought to such condition that the State will derive considerable revenue from them;

It is hereby Resolved, That the General Assembly, at its session of 1909, consider most carefully the recommendations of this convention, which have the endorsement of the U. S. Bureau of Fisheries, and that they take up these recommendations and act upon them immediately.

And be it further Resolved, That the Speaker of the House and the President of the Senate be requested to appoint a joint committee of members not only from the eastern portion of the State but also from the central and western portions who will go over these recommendations of the convention; confer with the Fish Commissioner, Oyster Commissioner and State Geologist; and embody these recommendations in one general bill to be acted upon by the General Assembly.

WHEREAS, It will be of advantage to the committees on fish and oyster of the General Assembly of 1909 to have all information possible relating to these industries;

It is hereby Resolved, That the Fish Commissioner, Oyster Commissioner and State Geologist be requested to be ready to give all information possible to these committees when so requested.

WHEREAS, It is believed that it is to the best interests of the State that all counties be under the jurisdiction of the Fish Commission;

It is hereby Resolved, That all counties be requested and urged through their members in the General Assembly to come under the jurisdiction of the Fish Commission and assist in its work, which is the building up and increasing in value the fishing industries of the State.

WHEREAS, It is believed the oyster industry can be made a source of income to the State; *Provided*, the laws are enforced;

It is hereby Resolved, That the General Assembly of 1909 be petitioned to make a sufficient appropriation for two years to support the Oyster Commission so that it will be enabled to enforce the laws and collect the oyster tax and be in a position to carry out the work of the Commission to the best interests of the State; and that the amount required be recommended by the Oyster Commissioner.

PUBLICATIONS
OF THE
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

BULLETINS.

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UNIV. OF THE COAST.

JAN 7 1913

**NORTH CAROLINA GEOLOGICAL AND
ECONOMIC SURVEY**

JOSEPH HYDE PRATT, STATE GEOLOGIST

ECONOMIC PAPER NO. 17

**Proceedings of Drainage Convention Held
at Newbern, North Carolina,
September 9, 1908**

**COMPILED BY
JOSEPH HYDE PRATT**



RALEIGH

E. M. UZZELL & Co., STATE PRINTERS AND BINDERS

1908

**PROCEEDINGS OF DRAINAGE CONVENTION HELD AT NEWBERN,
NORTH CAROLINA, SEPTEMBER 9, 1908**

**COMPILED BY
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1908

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LETTER OF TRANSMITTAL

CHAPEL HILL, N. C., December 1, 1908.

To His Excellency, HON. ROBERT B. GLENN,

Governor of North Carolina.

Sir.—I herewith submit the report of the Proceedings of the Drainage Convention that was held at Newbern, N. C., September 9 and 10. In this report are given the addresses delivered at the Convention and also the legislation recommended. On account of the value of this report to the question of drainage in eastern North Carolina, I recommend that it be published as Economic Paper No. 17 of the publications of the North Carolina Geological and Economic Survey.

Yours respectfully,

JOSEPH HYDE PRATT,

State Geologist.

CONTENTS

	PAGE
INTRODUCTION	9
PROCEEDINGS OF THE CONVENTION.....	10
Purpose of the Convention, by Joseph Hyde Pratt.....	10
Organization of the Convention.....	12
Address of Welcome, by M. H. Allen.....	15
Address by Congressman John H. Small.....	17
How to Drain our Swamp Lands, by J. O. Wright, Drainage Engineer.....	24
Appointment of Committees on Legislation and Resolutions.....	32
Address by Senator F. M. Simmons.....	32
Address by Congressman Charles R. Thomas.....	39
Cost and Value of Drainage, by E. W. Myers, Consulting Engineer... ..	43
Drainage of Swamp Lands and its Relation to Public Health, by Dr. Francis Duffy	52
Discussion by Dr. Caton.....	56
Address by Congressman H. L. Godwin.....	57
Practical Results of Drainage, by J. A. Wilkinson.....	60
Report of Committee on Resolutions.....	61
Report of Committee on Legislation.....	64
Legislation recommended by Committee.....	64
Assessment of Benefits and Damages in a Public Drainage District, by J. O. Wright.....	79

PROCEEDINGS OF DRAINAGE CONVENTION

CALLED BY THE GEOLOGICAL BOARD AND HELD AT NEWBERN, N. C.,
SEPTEMBER 9 AND 10, 1908.

COMPILED BY JOSEPH HYDE PRATT, STATE GEOLOGIST.

INTRODUCTION.

The State Geological and Economic Survey has been interested in the subject of drainage for the past four years and has given special attention to the problem of drainage of certain of the swamp lands belonging to the State Board of Education. During this investigation the State Geologist was impressed with the enormous amount of swamp land in eastern North Carolina and its present unproductiveness. It was also observed that much of this swamp area was capable of being drained and would then make good agricultural lands; but that there were no adequate laws in the State which would warrant any one undertaking the drainage of any swamp area.

Realizing these conditions and also realizing what it would mean to eastern North Carolina if certain of these swamp areas were drained, the Geological Board at its June meeting authorized the State Geologist to call a meeting to be held at some central point in eastern North Carolina to consider the drainage problem and to recommend legislation that would make the drainage of these swamp areas practical. While this meeting was open to all who wished to attend, two or more special delegates were appointed from the twenty-eight counties in eastern North Carolina that contained swamp areas.

The following letter was sent out to each of these delegates:

NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

CHAPEL HILL, N. C., July 24, 1908.

Dear Sir.—At the June meeting of the Geological Board the State Geologist was authorized to call a meeting to be held at some suitable point in eastern North Carolina to which delegates would be appointed to take up a discussion relating to legislation that may be deemed necessary to give to North Carolina such laws as will make it possible to carry out profitably the drainage of swamp and overflow lands. This meeting will be held at Newbern, N. C., September 9 and 10, at the Hotel Gaston.

I shall appreciate it if you will attend this meeting as a delegate. There are no funds available for paying expenses of delegates and you will, therefore, have to defray your own expenses at the meeting.

Trusting to hear that you can attend this convention, which I consider of the utmost importance to North Carolina, I beg to remain,

Yours very truly,

JOSEPH HYDE PRATT,
State Geologist.

In response to this letter, over forty delegates attended the convention.

PROCEEDINGS OF THE CONVENTION.

The first meeting was called to order Wednesday morning, September 9, at 10:30 o'clock, in the court house, by Joseph Hyde Pratt, State Geologist. In calling the meeting to order, Mr. Pratt spoke something as follows:

PURPOSE OF THE CONVENTION.

BY JOSEPH HYDE PRATT, STATE GEOLOGIST.

This convention has been called to discuss a most important question, and one that is interesting not only many States but the Federal Government.

Although the question of drainage comes home more forcibly to the people of eastern North Carolina than any other portion of the State on account of the very large area of swamp lands in that section, it is a question of importance to all the people of the State, inasmuch as it means the reclamation not only of swamp lands but also of "overflow" lands. There are approximately 4,505 square miles of swamp lands in North Carolina, besides thousands of acres of "overflow" lands, many of which are susceptible to reclamation, if properly drained. In many instances, no engineering difficulty has stood in the way of draining a particular piece of land, but absence of adequate laws. There is no general drainage law in North Carolina, although several counties and townships have had laws passed relating to the drainage of areas within their borders. Thus, it has happened quite frequently that a scheme for draining certain areas has had to be abandoned because, in order to carry out successfully the plan of drainage, it would be necessary to go beyond the boundary line of the township or county and in this adjacent territory there were no laws relating to drainage. If these large areas in the State are to be successfully drained, it will be necessary to have some general legislation passed covering the whole State with certain supplementary laws to govern certain local conditions. There is no doubt but that the Federal Government is beginning to take a most decided interest in the

reclamation of swamp lands and, when Congress passes laws permitting Federal aid to States in the reclamation of swamp lands, it is those States that have practical drainage laws that will undoubtedly be the first to obtain co-operative aid from the Federal Government.

When we consider the area of swamp lands in North Carolina, that it is nearly as great as that of the kingdom of Saxony, which has nearly 5,000,000 people, it will be seen that the State has the opportunity of developing an area which is capable of supporting a population that is larger than the present population of the whole State. Although some of the swamp areas do not contain land that is very well adapted to agricultural purposes, still there are vast areas which, if drained, would be capable of growing a vast variety of products. They would not be far from railroads so that the products of the farms could be easily marketed.

A large proportion of the swamp lands is sufficiently elevated above the neighboring water courses to make drainage feasible, but usually this is beyond the reach of the individual. It is possible to accomplish this if the laws of the State will permit different interests joining together to carry out these large drainage schemes and to issue bonds to obtain the necessary funds to accomplish their end.

Congressmen Small, Thomas and Godwin, of the First, Third and Sixth districts, respectively, are heartily in accord with what is being done in regard to drainage in the State, and have worked zealously for the success of this movement. Mr. Small especially has carried on a very vigorous campaign for practical drainage. He has had Mr. J. O. Wright, of the U. S. Bureau of Agriculture give a great many addresses in his district on the question of drainage, which have aroused considerable interest in this important work. Mr. Godwin has also most thoroughly identified himself with the reclamation of swamp lands in North Carolina, and in March, 1906, made a speech on the floor of the House of Representatives favoring Federal aid to States in the reclamation of their swamp lands.

Many of the States have already taken up the question of drainage and have passed satisfactory laws which are resulting in the reclamation of large areas of otherwise valueless lands, and this has meant a considerable increase in the revenue of the State. It is my desire that the result of this convention will be the passage of adequate laws at the General Assembly of 1909 which will permit of the drainage of our vast swamp areas, thus bringing them into cultivation and by this means add a considerable revenue to the State from a source which is now yielding practically nothing.

The 4,505 square miles of swamp land in eastern North Carolina is in 28 counties as follows:

County.	Sq. mi.	County.	Sq. mi.
Beaufort.....	177	Jones	139
Bertle	57	Martin	86
Bladen	192	New Hanover.....	25
Brunswick	300	Onslow	134
Camden	162	Pamlico	325
Carteret	126	Pasquotank	80
Chowan	30	Pender	370
Columbus	300	Perquimans	92
Craven	238	Pitt	40
Cumberland	30	Robeson	130
Currituck	40	Sampson	18
Dare	344	Tyrrell	251
Duplin	125	Washington	262
Gates	45		
Hyde	387	Total	4,505

or 2,883,200 acres.

The drainage of this vast swamp area means not only additional wealth to the State in the form of reclaimed agricultural lands, but it will mean improved roads in large areas that are now almost impassable and inaccessible; it will mean better school facilities for our children; and it will also greatly improve the healthfulness of those sections of the State.

On motion of Congressman Charles R. Thomas, the temporary chairman appointed committees on permanent organization and credentials as follows:

Permanent Organization.—C. R. Thomas, chairman; R. H. Morgan, S. W. Wilkinson, J. G. Butler and E. W. Myers.

Credentials.—E. H. Meadows, chairman; W. W. Ashe and S. W. Woodley.

The Committee on Permanent Organization reported the following permanent officers:

Chairman: Joseph Hyde Pratt, State Geologist, of Chapel Hill.

Secretary: G. V. Richardson, Dover.

Vice-Presidents: P. H. Morgan, Currituck County; F. F. Cahoon, Pasquotank County; John A. Wilkinson, Beaufort County; W. F. Davenport, Washington County; A. B. Croom, Jr., Pender County; J. J. Wolfenden, Craven County; E. M. Koonce, Onslow County; John C. Parker, Jones County; W. S. Chadwick, Carteret County; J. G. Butler, Columbus County; P. Rourk, Brunswick County; S. S. Mann, Hyde County; O. L. Clark, Bladen County; Dr. H. C. Lilly, Cumberland County.

The Committee on Credentials reported the following delegates present, representing their respective counties:

Beaufort County:

Congressman John H. Small, Washington.
H. C. Carter, Jr., Washington.
J. A. Wilkinson, Belhaven.
S. W. Wilkinson, Belhaven.

Bladen County:

O. L. Clark, Clarkton.

Brunswick County:

P. Rourk, Shallotte.

Camden County:

W. G. Ferebee, Gregory.

Carteret County:

W. S. Chadwick, Beaufort.

Columbus County:

J. G. Butler, Fireway.

Craven County:

Congressman C. R. Thomas, Newbern.
G. V. Richardson, Dover.
T. A. Green, Newbern.
A. D. Ward, Newbern.
E. H. Meadows, Newbern.
J. J. Wolfenden, Newbern.

Currituck County:

A. B. Lukens, Moyock.
R. O. Bayley, Moyock.
C. R. Vandecarr, Moyock.
P. H. Morgan, Shawboro.

Greene County:

D. M. Patrick, Snow Hill.

Guilford County:

E. W. Myers, Greensboro.

Harnett County:

Congressman H. L. Godwin, Dunn.

Hyde County:

S. S. Mann, Swanquarter.
F. H. B. Gibbs, Fairfield.
E. P. Carter, Fairfield.

Jones County:

Senator F. M. Simmons, Trenton.
T. D. Warren.
John C. Parker, Olivers.

New Hanover County:

J. A. Taylor, Wilmington.

Onslow County:

E. M. Koonce, Jacksonville.

Orange County:

Joseph Hyde Pratt, Chapel Hill.

Pamlico County:

J. F. Cowell, Bayboro.
William Brinson, Reelsboro.

Pasquotank County:

F. F. Cohoon, Elizabeth City.

Pender County:

A. B. Croom, Jr., Burgaw.

Wake County:

W. W. Ashe, Raleigh.

Washington County:

S. W. Woodley, Cherry.
A. G. Walker, Creswell.
John Phelps.
W. S. Davenport, Plymouth.

J. O. Wright, Washington, D. C.

The reports of the committees were unanimously adopted.

On the adoption of the report of the Committee on Permanent Organization, Mr. Pratt expressed his appreciation of the honor of being made chairman of the convention and said, among other things, that he hoped to see a bill pass the Legislature of 1909 which will permit of the drainage

of the swamp lands of North Carolina. He then called upon Attorney M. H. Allen, who made the address of welcome in the absence of Mayor Jas. A. Bryan. Mr. Allen spoke as follows:

ADDRESS OF WELCOME.

BY MR. M. H. ALLEN.

Gentlemen of the Drainage Convention:

The distinguished citizen who should have greeted you being for good reasons absent, it has become my duty to imperfectly fill his place. A most pleasant duty, so far as the expression of kind feeling is concerned, and undeserved duty, if I look to the comparison you must draw between the Mayor of this city and an ordinary layman.

Both Newbern and Craven County congratulate themselves upon furnishing the forum in which shall be considered the great question of the drainage of our swamp lands—a matter which pertains to the welfare of the whole of this great eastern section.

This age has been correctly denominated the age of experiment and advancement. The human mind seems to have burst its ancient limit and to be travelling over the face of the material and intellectual creation in search of the means of progress. In this section of North Carolina we have thousands and thousands of acres of the richest lands on the continent which, in its present condition, is of no value to the owner because it is not drained. The small farmer is unable to drain great bodies of land belonging to others in order to improve his own. Our Government has seen fit to loan millions of dollars toward the irrigation of the arid lands of the far West, and, if it can do so much for the people of that section of the country, may we not expect it to lend us a helping hand? If the laws enacted as a result of this meeting will so fix it that the small farmer can drain his land without the expense of draining the lands of others, we will see a wave of prosperity sweep over this section such as was never seen before.

We welcome you within our borders and extend to you a cordial appreciation and wish you every pleasure of success in your deliberations. Results are already guaranteed by the personnel of this assembly. When we see such men as you assemble in the interest of any cause, we are assured of the result. You must not forget, however, that you come upon a two-fold mission, first business and second, pleasure. I have the pleasure to greet you in the section to which belongs the distinction of having been selected by the first settlers to these United States. I have the pleasure to welcome you to the city and county to which belong the honor of hav-

ing been settled by that moral, sober, industrious, and just people, called the Palatines, who arrived on this long strip of land bounded on the north and south by a strip of shining river in the year 1709, and founded this city, which was called by de Graffenreid, New Berne, after the Swiss capital in the far-away Alps. Houses were built, streets laid off, and the field cleared and prosperity came. Warehouses were opened and ships from many ports anchored in the harbor of the two rivers, and so trade and commerce joined hands with agriculture to lift the little town to wealth and importance; and so toward the middle of the century, we find the Royal Governors making this their capital and here convening their legislatures. It was not perhaps until the days of Tryon that Newbern reached the zenith of social importance such as colonial Newbern. She has given to the State some of its most distinguished builders and defenders; many of the names known in the annals of the nation were first household words in Newbern; Craven on her doorplate and later on the marble slabs under the moss-draped elms in that portion of her domain called "God's Acre." Here are still some of the mementoes and landmarks of those lost colonial days. Here is that unburned wing of Tryon's palace which links us to the past. Here is Pollock street, perpetuating the memory of him who took up de Graffenreid's work. And here are some of the residences erected by the men of that lost time. Here is the Gaston Place, Nash Place and many others that have withstood the ravages of time and assaults of war.

The Newbern of to-day is a greater Newbern. It offers every advantage of factory, finance, electricity, health and happiness that is found within the borders of our State. Her progressive citizenship has forced her to the notice of the commercial world. I might dwell at length upon the magnificent strides of this town, were you not present to view with us these many evidences of progress.

Gentlemen, we want you to feel at liberty to take for your comfort everything in sight that is eatable or drinkable, and if there is anything you want which you do not see, ask and it shall be given you.

I take pleasure in introducing you to the good people of Craven County, and in their names and in the name of the Mayor of this city, extend to you a heartfelt welcome to this hospitable and historic city.

The Chairman responded briefly to the kind address of welcome and then called upon Congressman John H. Small to address the convention, stating that the convention owed as much to Congressman Small as any other person on account of his untiring efforts in behalf of drainage.

Mr. John H. Small, Congressman from the First District, spoke as follows:

ADDRESS BY CONGRESSMAN JOHN H. SMALL.

Mr. Chairman and Gentlemen:

I am not called upon to respond to the very cordial address of welcome made by our distinguished young friend, Mr. Allen, but I cannot refrain from giving attention to one feature of the welcome which he extended, and that is that we are to partake of all that is drinkable in the City of Newbern. I have heard the story of Tantalus, who was condemned to stand in water up to his mouth with never the privilege of drinking a drop, the waters receding whenever he attempted to do so, but that was not equal to the proposition suggested by Mr. Allen when he invited us to drink in a dry town. If he had had in his mind simply the presence of water, then we would have understood him, because on this occasion at least there is water, water everywhere, and also many drops to drink.

I cannot justify, gentlemen, the compliment which has been paid me by being placed upon the program to speak at this notable convention, but the importance and the appropriateness of this convention will justify the efforts of any citizen in North Carolina to help make its deliberations a success. I feel that these people of North Carolina represent the most important factor among its resources, and that which will count more for its development, the soil. There are men from these large number of counties who are willing to leave their business and their homes and come to this good city for the purpose of lending their aid and their ability and their judgment and their means toward the solution of what we must all regard as one of the vital problems of North Carolina, the drainage of our lands.

Twenty-five years ago, perhaps that is the correct period to which to recur, the swamp lands of eastern North Carolina were regarded as practically valueless. In those times the average man did not care to own such lands. About that time timber came into demand, a value was created for it, and then these swamp lands were regarded as having some value, by reason of the forest growth upon them, and so it continued, until by reason of this demand individual landowners parted with their holdings, primarily on the part of the purchasers for the purpose of getting the timber, and the owners, so anxious were they to get something of value for those lands which they had held for so long without any profit, were frequently willing to include the land itself as a matter of inducement to those who wished to buy the timber. Speaking for myself, it is something of a revelation which has come to me to realize that these lands

have an intrinsic value of their own and constitute our most valuable lands. I simply had a hazy idea that perhaps in some mysterious manner these lands might sometime be drained, but there was no definite assurance that it could be accomplished. Those of us who have given some study to the question, and that constitutes many intelligent citizens of North Carolina, have learned that those lands may be reclaimed and that they may be changed from practically valueless lands into the most valuable areas in North Carolina. A report has recently been made by a gentleman connected with the U. S. Department of Agriculture, and who occupies the position of drainage engineer in that Department, and about which I shall have the pleasure of saying a word. He has characterized these lands as being as fertile as the lands in the Mississippi delta, and that all that is required in order to make them of such value and increase their productivity so that they shall rival the most fertile lands in the world, is to lower the level of the water by a system of drainage, so that these swamp lands of ours in North Carolina, a heritage which has come down to us in the early years of the 20th century, shall turn out to be, if this meeting shall be successful, as I believe it will be, as fertile as any lands which have been reclaimed in the past.

Not only do the unreclaimed swamp lands of eastern North Carolina involve the problem of drainage, but the lands which we have improved, which were cleared and put to the plow years ago, also require drainage to the same extent in order to make them profitable for cultivation.

Mr. Chairman, I have personal knowledge of one county in eastern North Carolina, one of the most fertile and prosperous counties in the State, the county of Hyde, whose lands for one hundred years or more have produced abundant crops, and which are famous beyond the limits of the State, until she came to be called the granary of North Carolina. For three years, including this, they have had failures of crops there by reason of the lack of drainage of their lands. Those areas that have heretofore been regarded as so extremely valuable, so that they could not have been bought during the last one hundred years for \$100 an acre, are valueless during such years as the past three. What a misfortune it is that fertile lands in a county possessing men and women of intelligence and culture, a county where there is as little provincialism as in any agricultural county in North Carolina, should suffer under such conditions. How must such a state of affairs in a section like that appeal not only to landowners in that county, but to the civic spirit of every citizen of North Carolina to reclaim their lands and bring them back to their original productivity, if it can be accomplished. Unfortunately, however, that county is simply typical of others. There are other counties

I doubt not in eastern North Carolina in which the conditions are possibly not so acute, and yet their experience during the past three years has been so disastrous as to demand some remedy by which their lands may be drained and their productiveness restored.

Not only, gentlemen, is it a question of our swamp lands and our improved lands in eastern North Carolina, but there are fertile river bottoms in the territory just west of us and in the Piedmont section, heretofore noted for their fertility, which during recent years have been inundated by floods, and they are equally interested in this question of preserving their lands from overflow so that their productiveness shall be maintained.

These are some of the problems, gentlemen, which confront the people of North Carolina. I mention the river bottoms in the upper sections of the State for the purpose of illustrating that this problem is not peculiar to eastern North Carolina, but that it concerns the whole of the State.

What is the remedy, gentlemen, for this condition? I stated a little while ago that this question of drainage was formerly regarded by me as impracticable. I have now reached the conclusion that it is entirely practicable to reclaim the greater part of our waste swamp lands and that it is absolutely practicable to drain every acre of these lands which have been improved and reduced to cultivation. It is a practical problem and it may be solved. How may it be solved? Drainage has two characteristics. It confers two kinds of benefits. One benefit is to the owner of the land by the increase in its productive capacity and thereby increasing its actual value. That is the private benefit. There is another class of benefits, and among them may be counted the improvement in the public health, and improvement in the highways, and the improvement and promotion in the general welfare of the country. These are public benefits. The distinction between these and the necessary relation which they bear one to another may be pointed out briefly in just a few minutes.

How may our lands be drained? Unfortunately in North Carolina in the past each landowner with his individual tract of land has endeavored to drain his land himself without reference to his neighbors. That cannot be done. The only successful method by which land may be drained is to include in one area or drainage district all of the lands which have a common outlet, and to carry the water from all these lands into the common outlet. With one or more large lateral branches or canals leading into it from all the lands in the district, the large area may be drained. It is impossible for one individual to effect such a purpose. A man may own a tract of land and the outlet may be three or four or five or ten miles distant. If he attempts to cut the proper canal from his land it must go through other lands. It is impossible for the landowner to do

this within reasonable cost. Therefore, it is impracticable from a pecuniary standpoint. On the other hand, even if he had the means, he is draining the lands of ten, fifteen or twenty-five landowners between his land and the common outlet. Should this landowner be compelled out of his own pocket to bear the cost of the drainage of the lands below, and they not contribute to the expense? Hence you have two difficulties, the very difficulties which are confronting thousands of landowners in eastern North Carolina. How is that problem to be met? It is the same old story of the necessity of co-operation one with another. These contiguous landowners must get together. By that spirit they will furnish the means and drain all of the lands situated within these drainage areas and having a common outlet, and thereby the result will be accomplished and the water level will be lowered to a sufficient depth so that they may look for reliable crops on their farms.

May I philosophize upon this point? I wish to say that the lack of this spirit of co-operation is one of the civic defects of our people. There is not sufficient co-operation one with another in order to accomplish public benefits and bring about results. It is not peculiar to any particular section, but, in my judgment it is a common defect of us all. Some of the best things in life, those which make for the progress and uplift of humanity can only be accomplished by this spirit of co-operation. Let me mention a few. One of the most important problems for solution in North Carolina are improved highways. We have illustrations in many sections of the State and in some of the eastern counties particularly, where we have no better highways than we had many years ago, and during all these years they have been a disgrace to the people. We will not have better highways until we unite together and by dividing the burden among us do whatever may be required to make better highways.

We have heard much during these last few years about the illiteracy which prevails among the white people in North Carolina, and we have heard that the only way by which all the children may be educated is by the public schools supported by local tax, and this may only be accomplished by this spirit of co-operation. You find a community which seems to be progressive, and you ask the reason, and the most usual reply is that the people are public spirited, and that expression translated simply means that there are a number of men and women in that community who are willing to unite one with another and bring about these public improvements which make for progress.

I shall not detain you longer by philosophizing upon this question. But I repeat and I repeat with emphasis, and I will be able to demonstrate to you in one moment, that only by this spirit of co-operation can

we drain these bodies of wet lands in North Carolina. Unfortunately, however, in this world of ours, we can never expect to have absolute unity. We may have in a drainage area or district twenty-five landowners. It will be a very remarkable condition when all of these landowners are willing to unite with each other and contribute their share to the burden in draining this land in such drainage district. How are you going to drain your lands against the objections of the few? Shall the project be stopped? Shall A. who owns a farm which only needs drainage to promote its productiveness be prevented from draining his lands because B., C. and D. will not join with him? That is the problem that has confronted us in the past. We must solve that problem if we shall successfully drain these lands. How can it be done? Under our Constitution and the laws you cannot cross a man's land, you cannot compel a man to go into his pocket and pay taxes for the benefit of A., who owns a farm here. You can only cross his land or tax his property because of the public benefit which results from this drainage; because the public health will be promoted; because we cannot have good highways without draining these lands; and because the public welfare will be promoted by this drainage.

The outside world believes that eastern North Carolina is unhealthy. There are some ignorant folks living west of Raleigh who yet think that it is unsafe to come to eastern North Carolina. We do have some malaria down here, and I have never yet found a place where it did not exist. I thought I found a place once in Massachusetts exempt from malaria, but I was mistaken. Upon this question of healthfulness in eastern North Carolina, we know that it is a problem easy of solution, for with good water, with drained lands and with screened houses I could live, and you could live in any swamp in eastern North Carolina with just as much security from malaria and disease as you could upon the top of Mt. Mitchell.

So this question of drainage bears direct relation to the promotion of public health. I may say that whenever we drain these lands and when we get good water, as we may get anywhere in eastern North Carolina by deep wells, then we may go into the great States of the Mississippi valley where there are thousands of families who wish to change their location and invite them to settle on our rich lands and participate in our prosperity.

By reason, gentlemen, if you please, of the public benefits resulting from drainage, the Legislature may confer upon an association, or drainage district the right to compel each landowner within such drainage district to join with the other landowners and contribute to the expense of drain-

ing all the lands within the district. They may say you shall contribute your share of the burden, and it is upon this basis that it has been found practicable to drain our swamp lands.

One of the purposes of this meeting is first to focus the attention of the people of North Carolina upon this question of drainage, and to let it go forth as a distinct declaration of these gentlemen who are gathered here, that it is absolutely practicable to drain these lands. Our next object should be to frame a law and submit it to the Legislature which will make it possible to organize these drainage districts whereby our lands may be successfully drained. We have a drainage law, but it is entirely inadequate. We need a modern drainage law, and this convention ought to set on foot a movement which will result in the enactment of a proper law. Others have had this problem presented to them just as we have had it presented to us, and have solved it. We should frame a law which shall be submitted to the next Legislature with the request that it be enacted into a law. I believe, gentlemen, that this meeting will be successful in both of these purposes.

I cannot take my seat, gentlemen, without referring to two men who have been conspicuous in this movement. Last year there came into North Carolina a gentleman from the U. S. Department of Agriculture, who occupies the position of Supervising Drainage Engineer in that Department. If he desires he may close his ears for a moment now. He is present with us. He is one of the foremost drainage engineers of the United States. He has had experience in the States of Missouri, Illinois, Indiana, and Iowa. He has also had years of experience in the State of Louisiana, where they have solved the question of drainage under conditions much more difficult and expensive than any which confront us, and with his skill and experience he saw these lands in eastern North Carolina, saw how crops were cut off in 1907, as they had been in 1906 in some of our counties, and he became interested and resolved to study this problem of drainage in our section of the State. I have had my admiration excited by his zeal and his disposition to serve our people. That is particularly noteworthy, because the average official living in the City of Washington soon learns to love his seat in the office better than anything outside. Mr. Wright has made a number of trips down here. He has been with us this summer, and I know of no man who has contributed so much to initiate this movement as Mr. J. O. Wright of the City of Washington. We all owe him a debt of gratitude. He had the great fortune some years ago (I will not say how many), to be born in the County of

Guilford, and when a boy his parents moved to the State of Indiana. It has given me great pleasure to pay this tribute to this unselfish, zealous, public-spirited man who has contributed to a movement which means so much to the welfare of North Carolina.

I wish to say just one thing more due another gentleman. In the early days of this movement there accompanied Mr. Wright in his visits through eastern North Carolina a gentleman who is at the head of our State Geological and Economic Survey. You know that the Legislature in 1905 widened the work of our State Geological Survey so that it includes not only subjects relating to geology, but drainage, public roads, fisheries, and perhaps one or two other subjects, which I do not now recall. Almost from the very beginning Dr. Joseph Hyde Pratt, our State Geologist, has been unceasing in his efforts to secure information and to promote this movement which is taking shape to-day. He is entitled to conspicuous mention and to the gratitude of the people of North Carolina.

I have detained you longer than I anticipated with this rambling talk which I have made to you. I am glad to be one of you and to work with you, not as leader, because I am not entitled to that distinction, but as one in the ranks to contribute my share in whatever way may lay in my power to foster this great movement, which means so much to the progress of North Carolina.

I was particularly desirous of impressing upon you a few basic propositions. I submit that the problem of drainage is a public question and confers a public benefit. That thereby drainage districts may be formed, and lands taken and taxes imposed for the purpose of paying the bonds and other expenses incurred in executing the plan of drainage. That it is necessary for the Legislature to enact a modern drainage law. That our people must be educated up to the importance of drainage, and to a knowledge of how the same may be accomplished. That it is necessary to inculcate the spirit of unity and co-operation, in order to give effect to the law and to secure the best results. That the result of this drainage movement, if carried forward successfully, will be to add a large area of fertile lands which will attract settlers from other States and make greatly for progress and prosperity.

In introducing the next speaker, Mr. J. O. Wright, Drainage Engineer of the U. S. Department of Agriculture, the chairman referred to him as the leader of the drainage work in the South and one who has already been of very great assistance to North Carolina in the investigation of her drainage problems.

HOW TO DRAIN OUR SWAMP LANDS.

BY J. O. WRIGHT, DRAINAGE ENGINEER.

The value of any kind of property depends upon the amount of money that it will return to its owner. Railroad stocks depend upon the amount of interest you get from them. The value of property depends upon the certainty of getting a return and the amount of this return. That is true of all kinds of property and it is particularly true of agricultural property. If you go to any country and find a farm that is producing a good crop every year, that farm is worth a great deal of money; and much more than a farm in the same vicinity that will produce only a poor crop when the season happens to be right; for the owner of the latter farm does not know when he plants his property whether he will get any return or not. If you have a piece of property that brings no revenue, it is necessarily not in demand and has very little value. Now, property may have a speculative or prospective value. For instance, if it was announced that the railroad company was going to put up a large shop at Newbern and employ a large number of men and build cars, property for miles around would begin to go up in value right away. The land would not be worth any more, but would have a prospective value, depending upon something happening. If the shops should be built, the men might realize that value.

I find that there is in eastern North Carolina about three million acres of land that is classed as overflow lands, and is made up of a soft marsh. Then there is a larger area of land that is overflowed practically all the year round called swamps. There is still another body of land lying a little higher than the swamps that is in cultivation, which sometimes produces a crop and sometimes not. In Hyde County, as Mr. Small mentioned, the crops have for three years been almost a complete failure. There have been times when they had good crops, but it depends upon the dryness of the season and, therefore, the land does not have the certainty of producing a crop each year that is necessary to make the land of great value. I have been over there this year and I found on the high ground good crops, but on the low grounds that are more fertile there were no crops at all. Thus, you are farming in eastern North Carolina land that is productive some years and some years it is not. You have in eastern North Carolina very rich overflowed and bottom lands that are liable to overflow from the river and by back water from the swamps. If you have an excessive amount of rain, the crops are a failure and this is the condition that I have found in eastern North Carolina during the last two or three years. These lands that I have described have not a great deal of real value. The soft marsh is absolutely worthless, unless tim-

bered, and the swamp land has no real value, unless it is also timbered. There is no loss in swamp lands, but there is a great loss in cultivated lands. If a man goes to the trouble of ploughing his land and planting his seed and then gets no return, he has lost his time and his seed and often he has lost heart. The next year he does not know whether he will succeed and does not go at his work with as much vim and energy. I have had men to tell me in eastern North Carolina that they have lands that are not as productive as they were a number of years ago—that conditions are getting worse. The land is not worth as much now as it was twenty-five, fifty or sixty years ago. The owners of these lands have before them, if they could realize it, a very rich inheritance. You have kept these lands a long time, and outside of the timber you have sold you have received no revenue.

I take it that the people who have come to this convention are interested in drainage. Congressman Small has detailed some of the difficulties which confront you. I am here to tell you how you can overcome these difficulties. I know how it has been done in other places and what other people have done you can do. When I left North Carolina in 1868, I went to Indiana. I had letters from friends there telling me what wonderful opportunities were there for young men. I went out there and found the country was sparsely settled. Large tracts of land were put into cultivation, some of which at that time was worth from \$25 to \$30 and \$40 an acre, but the greater portion of the land was only worth from \$5 to \$15 per acre. The northern part of the State was prairie land with no trees whatever on it. The section where I located was composed mostly of timber lands. It was three and a half miles to the postoffice, part of the way across a swamp known in those days as "hog pool sloughs." In order to pass at any time of the year a corduroy road was made for half a mile, but it was not possible to get through the swamp more than half the year, and it was an extra three miles around the swamp. It was impossible to build a road through it. That was the condition of that country at the time I mention. The people raised more or less corn on these lands, but when they would gather it, it was soft corn. It was so wet in the spring that you could not plant corn at the proper time. To overcome this, one man introduced a corn that would mature in ninety days. You could get from sixty to seventy bushels of corn to the acre, but it was the quality that it lacked. You could grow some wheat and a little oats. Now you can go to that country and find it laid out in sections, with well-improved hard roads, many surfaced with stone. You will find the sloughs or swamps have all been drained and that a great many of the farms have been tile drained; you will find the people

prosperous, and if you ask the value of farm lands, they will tell you \$120 to \$125 an acre. The whole solution of their problem was drainage; they drained their lands and were thus enabled to grow large and good crops. Land in Indiana to-day would not have been worth any more, or very little more than it was when I went there, if it had not been drained.

There is nothing particularly difficult about drainage; but it takes time and it takes money. The soil out there is not any better than your soil here in eastern North Carolina and the climate is not so good. A bushel of corn is worth ten or eight cents more in North Carolina than out there. They cannot raise the vegetables and potatoes that you can here in eastern North Carolina; and I cannot see why the conditions here are not superior in every way to the conditions I found in Indiana when I went there. You have the soil and you have the climate; in fact, you have everything that goes to make up a magnificent country but drainage, and why not have drainage? After living in Indiana for a few years I became a civil and drainage engineer and started out giving my whole time to drainage. My business called me a little further west into Illinois where I found prairie lands and conditions very similar to those in Indiana. I don't usually like to read what other people have said, but I want to read from a paper by the State Drainage Engineer given in the report of the last annual meeting of the Iowa Drainage Association:

Before drainage districts were organized and the general drainage of the country accomplished, all the central portion of Illinois, which is now the most fertile and highest priced land in the State, consisted of successions of low ridges and shallow depressions varying from a few rods to a mile or more in width. The depressions during the spring and summer months, the planting and growing seasons—being either lakes or swamps impassable and of no value to the owner and a source of malaria and ill health to the inhabitants. Every county in this whole section of the State had large tracts of land which the government could not sell and which were donated to the county as "swamp lands," the proceeds of the sale of such lands to be used for the drainage thereof.

Upon the enactment of practical drainage laws, the farmers proceeded to the organization of drainage districts, both large and small, for the construction of open ditches and for the construction of tile ditches, and they have drained a large portion of the area of the wet lands of Illinois and have reduced the swamps and ponds and sloughs to fertile fields on which abundant crops of corn, oats and wheat and grass are raised from year to year. Public highways have been laid out at frequent intervals and are usable at all seasons of the year, notwithstanding improvements known as hard roads would be of great benefit in many localities. The value of the products of the farms has increased from five- to ten-fold over the old conditions and the value of the lands themselves have increased from their former prices of \$5.00 to \$25.00 per acre, until practically all well-drained lands in central Illinois to-day are

worth on an average of \$150.00 per acre. Without the benefit which accrued from drainage, these lands would be as worthless and probably lower priced to-day than they were twenty-five years ago.

I simply read that to corroborate what I have said about Indiana. I know this from my own personal experience and I am satisfied that if this same method was employed in eastern North Carolina that has been employed in Indiana, Illinois and Iowa and other States that I could name, that the same results would be just as sure to follow. We have the same conditions here, and if you apply the methods you are bound to obtain the same results. You will increase the productive power of the land and, still better, you will bring into cultivation a great deal of land that now is absolutely worthless for agricultural purposes. You will also increase the actual selling price of the land a great many fold. You ask how this work was done? That is my business here, to tell you how this was done and how you can do the same thing here. In 1879 Illinois passed a State Drainage Law. Now, what I mean by a State Drainage Law is a law enabling the people in a locality to get together and drain a definite area of land. As you know, in this country we believe in the majority ruling and it is not possible to carry out a law until the majority of the people are in favor of it. So it is with a drainage law. It is possible to have a drainage law, if the people are in favor of it. The drainage law by itself will not drain your lands. You may have the same law that they have in Illinois or in Iowa and it will not drain your lands until there is a public sentiment behind it. If in a community there is one man in favor of drainage and everybody else opposing it, it would not be a wise thing for that man to try to carry on drainage. The Illinois law provides that when a certain number of people owning land within a given territory petition the court setting forth that a certain territory is wet and overflowed and ask that this land be drained, the court will appoint an engineer and two men as viewers to look over this territory and report back to the court. These people go out and look the territory over and report to the court, and if the court finds that the drainage of said territory is practicable and that the work will benefit the public in any way, it orders the drainage district established. As you see, it simply requires the writing of a petition and filing it before the court, the Superior Court or your County Commissioners; the appointing of an engineer and viewers to go out and examine the territory and come back and report to the court or County Commissioners whether it is conducive to public benefit and if so, establish that territory into a drainage district, and the district becomes a corporation. That district is bounded by certain defined lines and nobody outside of those lines is affected.

The next step: You cannot take a man's property or cause him to incur any expense without his having notice and, therefore, when this petition is reported to the court, they cause notice to be given that on a certain day this report of the engineers and viewers will be heard and considered, and the people can come from all over the district. They can take this report and examine it and see if it is right. If they think there is some land still out that should be brought in, they can say so. They can also say if they think there should be another district. If they think there is some land that would not be benefited that should be excluded, this can be taken up and thus, after everybody is satisfied, nobody hurt, no expense incurred, for you have had to pay out no money, the court then appoints the engineer and viewers to make a survey. This first report is called the preliminary report. The engineer runs the lines and figures out the bounds of the ditches; he makes such changes as he thinks best, and he figures out the number of cubic yards that should be in each ditch. He makes a map showing the lines of everybody in that district and how many acres each has. Two men go with him and they classify that land. They say which will be most benefited and how it will be benefited. They classify the land according to the benefit, as some land will be benefited more than others, and the cost of this work is to be paid by the landowner in proportion to the amount it will be benefited, and the land that receives the greatest benefit bears the greatest burden. So, after the engineer and viewers have completed their labors, they make another report. They have the land classified, the ditches laid out and the cost figures.

MR. SMALL: The report of the engineer and viewers does not specify that John Smith shall pay so much, but it gives the number of acres he has in Class A, B or C, and the court makes the calculation and applies the rule of law, depending upon how much is necessary in proportion to the number of acres in each class.

MR. WRIGHT: That is the right idea. The land that is benefited most is put in class A and the next in class B, and you may have four or five or six classes, and also have the number of acres in each class. This is the plan to be put before the people. They are notified that on a certain day they will hear a complete report of the engineer and viewers. It is put on file in the office of the clerk for a number of days where any one can examine it and see how many acres are in each class and whether your land is in the right class or wrong class. You have full opportunity of offering all kinds of suggestions and objections and these are heard by the court. After the objections are heard and changes made to the satisfaction of the landowners of the district, the court then confirms the report.

Thus far, you have not been asked to put up any money or do anything unreasonable. I believe you have an appraiser that goes around and assesses your property for taxation and then you have a report when you can come in and equalize them. You say, I am assessed too much on this property, and then it is decided what is just and right and you pay your taxes on that property at that assessment. That is exactly what we do in a drainage district. We get the number of acres of land and get the land classified according to the benefit it will receive.

Now the next step: If a man has got low swamp lands and no other means of making money, he cannot put up a ditch tax, and there is a ditch tax placed on every acre benefited. This man has no other income and it is pretty nearly the condition in the average drainage district. A great many people have swamp lands but little else. I say, there is no use in asking a man to pay a great sum for getting drainage when he has nothing but wet lands. He cannot do it. The people of Illinois could not do it. At first they divided the area to be ditched and each man was to come and cut out a small ditch. What happened? It was never done. After a while they found that kind of procedure would not work. Somebody conceived the idea that they would issue bonds for the drainage of the lands. First, they said the bonds would not sell, but the law provided that they might issue bonds bearing 6 per cent interest, and they should not be sold at less than par. They all sold and they never sold at any less than par, and at the present time they are at a slight premium. You take no risk; they are just as good as any bond on the market. The next step after the sale of the bonds is to contract the digging of the ditches. To do this kind of work it is necessary that it be done in large contracts and with improved machinery. You cannot dig them with a shovel. There are now many men known as drainage contractors who take these contracts at so much per mile. The bonds having been sold, the money is ready for the contractors as they complete their work and as yet no one in the drainage district has been called upon to pay any money. These bonds, however, have to be paid somehow. To my mind, it is best to have the first bond due in three years, then one bond to be paid every year thereafter for nine years, making ten years. At the end of the third year you have got to pay one-tenth of your ditch assessment. The cost has been assessed on these lands and you have got to pay one-tenth of that the third year. Suppose it cost \$4.00 per acre on a piece of drained swamp land. You pay one-tenth of that which is forty cents an acre at the end of the third year. Your ditches have been dug and you have got your lands drained, but now you are asked to come in and pay forty cents according to contract. Where is the man going to get the forty cents an acre? If

he cultivates that land that has been drained, he can raise corn enough on it to pay the tax on 100 acres. So the money you pay for this drainage comes off the land that has been drained. The next year you raise another crop and put more land into cultivation. It comes easier to pay the second installment than it did to pay the first, and before the ten years expires you are making enormous crops and you pay your drainage tax at forty cents an acre, and have a good balance to put in the bank. That is the way this work was and is still being done in the western States, but when it was first proposed out there, you never heard so much opposition. I have never yet heard of a piece of land that had to be sold to pay the ditch tax. I have never known of any hardships being imposed on any one because of an arrangement of this kind. I have been on the ground when the contract was let and when the work was completed, and I have known land to go from five to thirty dollars an acre on the strength of what was being done, and when the drainage was completed, it would stand at that value. I cannot see why the people of North Carolina in an arrangement of this kind would not be able to go ahead and drain their land and derive similar benefits. You cannot drain it all in one year, and it may take five, ten, fifteen or even twenty years, but whenever the land is drained, it will increase in value. Do you know of any large place now that will produce a good crop every year that can be bought for ten or fifteen dollars an acre? What is the price of that land? You could not buy it, and if you did, you would have to pay a good price for it. I want to tell you if you drain these lands, there is no reason why your lands will not increase in value. I don't know of any place where there is good, well-drained land lying idle. I travel a good deal and I don't know of any good agricultural land that is drained and will produce good crops every year that can be bought for less than \$75 to \$150 per acre. What obstacle is there that you cannot overcome? Can you get your Legislature to pass a drainage law? I think you can. If you have the drainage law, one man can write a petition and take it around and get some of his neighbors to sign it. It would take a few hours of his time but not a dollar of money. Then, let your contractor do the work and pay for it out of the money that you can get for sale of lands.

Now, as I say, the steps are these: First, the people have got to realize their condition and make up their minds that they want to better it. You have got to ask your Legislature to enact this drainage law and when you get it, you have then got to get behind it and put it into execution. It is a problem that one man cannot do. It is a problem that is best done by a community, but it is not a difficult problem. I could stand here all the afternoon and cite instances showing you the great benefits that have

accrued to various localities from the drainage of swamp lands, but it is not necessary. You may have some lands that you cannot readily drain. Take the lands that you can easily drain and drain them first.

The drainage tax is collected in the same manner as State and county taxes. When the land that is drained is worth ten, fifteen, twenty, or twenty-five dollars an acre, no man is going to stand in the way of paying the assessment. I have yet to find the first instance in which land is sold to pay the tax, unless in one or two cases of some lands belonging to non-residents, and they allowed the land to be sold and afterwards came along and redeemed it. The land is responsible. The tax is levied on the individual landowner, but it is against the land and not against the person.

It is assumed that no court would establish a drainage district if the cost of the work is going to be more than the profits derived from it; so when the benefits are so far above the cost, the land is absolutely good for it, and if the tax is not paid when due, it is up to the officer to collect it. The first payment can be made due at the end of the first year or the third year or fifth year. Different States have different times. It is my idea to have the first payment due at the end of the third year. The bonds carry with them a rate of interest payable annually or semi-annually, as the bonds may be drawn. During the first three years there can be sufficient tax levied to pay the interest alone. In some instances the court before whom this proceeding is held is authorized to go to some local bank or some person and borrow sufficient money to pay the preliminary expenses to the engineer and viewers, and pay the interest at such time as you can make it become due. That is anticipating a revenue. Land that is sold for tax is usually put up and bid in for just what the tax is.

QUESTION BY DELEGATE: Did you ever know a tract of land sold that failed to bring the amount of the tax?

MR. WRIGHT: I do not recall a single instance where land has been sold for taxes. In the early laws of Indiana, they required that the tax be paid cash down. I cannot recall a single instance in which I have known land to be sold.

MR. SMALL: A great many of our people believe that large areas in this coastal plain cannot be drained because the fall is not sufficient. Please express your judgment about how much fall there should be per mile.

MR. WRIGHT: That is practically an engineering question, and each case would have to be determined for itself; but I do not believe that you have any land in North Carolina, except some lands that are near the coast, that has not sufficient fall for drainage. I have been in a great

many places in which it was thought that there was no fall, but when the engineer examined it he found that there was considerable fall.

QUESTION BY DELEGATE: In connection with that, take a year like this, would drainage do much good in this locality or section?

MR. WRIGHT: This is just the kind of weather that you need it.

MR. SMALL: You mean to say that in your opinion that in the great bulk of our swamp lands that in years like the last two or three, if this system could be put into execution, that the lands could be drained?

MR. WRIGHT: Yes.

At the close of the discussion of Mr. Wright's address, the chairman appointed the following committees:

Committee on Legislation.—John H. Small, Chairman, J. O. Wright, E. W. Myers, A. D. Ward, A. B. Lukens, F. M. Simmons, C. R. Thomas, E. M. Green and E. P. Carter.

Committee on Resolutions.—John A. Wilkinson, Chairman, R. O. Bagley, E. W. Myers, W. G. Ferebee, C. R. Vandecarr, P. H. Morgan, D. M. Patrick and W. W. Ashe.

The next speaker was Senator F. M. Simmons, who spoke as follows:

ADDRESS BY SENATOR F. M. SIMMONS.

When the Chairman very kindly extended to me an invitation to address this convention, I replied to him saying that while I would be delighted to make a general speech, I did not desire to be put down for the purpose of making a set speech. I prefer rather to come to this meeting with a view to gain information rather than with a view of attempting to impart information. I shall, therefore, in what I have to say this evening, eschew altogether technical phases of this great and very interesting question that we have met here to discuss, because there are experts who have offered their services to enlighten this meeting, who surely know more about this question than I do and who surely can discuss them with much more intelligence than I can.

Mr. Small and Mr. Wright this morning discussed ably and exhaustively certain lines of thought relating to this subject which I had expected to discuss. If I were to attempt to travel over the same field, it would merely be a duplication or enlargement of their thought and I shall not weary the convention to do that. They have discussed the relation of the State, of the locality and of the citizen to this question of the drainage of swamp lands and uplands adjacent to swamps and affected by the overflow of swamps. I do not think anything could be added to what they have said

upon that line. Others are going to discuss some of the technical phases. For instance, Dr. Duffy is down to discuss the relation of this subject to sanitation.

There is another aspect of the question, however, thus far not presented by any delegate and not to be presented so far as the program indicates by speakers to follow me, upon which I think I might properly, for a short time, ask the attention of the convention, and that is the relation of the general Government to this subject. That is an especially interesting phase of the matter to me, because that is a feature of the drainage problem upon which I have reflected and upon which I have made some slight investigation.

The Duty of the Government.—The probability of the Government's lending its aid to the citizens, to the community, and to the State, to drain these swamp lands in the same way that it is to-day lending its aid to the States and the private citizens in the great deserts of the West to reclaim and to bring into proper cultivation the arid lands of those regions, is a very big and is becoming a very acute and pressing question throughout the country to-day. There are vast areas here in the South, here in North Carolina, hundreds of acres in separate tracts, ten thousand acres in other tracts, large areas either the subject of State ownership or private ownership not yet segregated into farms, which form, in my judgment, the basis of any thorough, complete and effective drainage of the wet lands of the South. When they are drained, when there are great canals wide enough and deep enough to float ocean-going vessels, running into these immense areas, taking the water out of them and leaving them high and dry land, then the problem of drainage upon the banks and in the adjacent territory will be a simple matter. How are we going to drain these vast areas? It has got to be done either by aid from the State or Federal Government.

I must now ask your attention for a few minutes to a discussion of the relation and the duty, according to my mind, of the Federal Government to this very important and interesting question.

In order that I may present my ideas with some degree of clearness so that I may get you to see this as it appears to me, let me go back a little.

When you consider the duty of the nation, you want to consider what the nation is, and it is nothing in the world but an aggregation of people. The citizen is the unit, the nation is the whole. Now the problems of the citizen and the problems of the nation are very much the same. They must be worked out on very nearly the same lines. Where the citizen, by reason of his limitation of means, or by reason of the restraints of the law, cannot work out the problem, then it becomes the duty of the State,

which represents all citizenship, to work it out for him, provided it may be done within constitutional and legal limitations. The problems confronting each are very much the same, and the problems change whether they be problems of the citizen or the State.

First, consider our country. How rapidly its problems have changed! We sometimes feel that this is an old country of ours, and yet, my friends, while it is old as we measure the span of a man's life, but, when we compare it with the great nations of Europe, it is a mere lad among the nations. We have been in existence as a nation less than one hundred and fifty years. In that time, how rapidly have the problems of the nation evolved!

In the first era the great problems which vexed the minds of patriots and statesmen were the questions connected with the security of life, liberty and property. The first era of our country was taken up with the discussion and the settlement of those fundamental questions. They were all settled wisely and well, in my judgment, with one exception, and that exception was the attempt on the part of our forefathers to link slavery and freedom and out of that exception grew the problems which absorbed the public thought of the nation during the middle era of our history, and which was not settled until the close of the Civil War.

After the war, our national problems became purely economic and industrial, and these are the problems with which we are dealing to-day.

It has been said that there never comes, in the life of a nation, a demand for a great man, a man of certain qualities and certain attributes, but that man is not raised up; and whenever the time comes for the settlement of a great problem, when that problem can no longer be put off, it presses itself upon every man, situation and condition in life, until it forces action. People do not appreciate a want until it becomes difficult to satisfy, or until the satisfaction of that want becomes impossible or unattainable.

Now, just so long in this country as we had vast areas of unoccupied lands available for farms and had great reaches of untouched timber, we thought that our supply of farm land and timber was inexhaustible, and yet, my friends, with only forty years of industrial activity, for our industrial activity really began at the close of the war, the available farms that could be purchased at a cheap price have been exhausted. I know that you can buy all the lands that you want if you pay the price, but what the Government demands for its citizens, what this new country of ours demands for the home builders is not high-priced land; and as long as it is possible within the limits of proper efforts to secure it, it is the duty of the Government to furnish cheap homes for the settler. The time

is rapidly coming in this southern country of ours when the poor man, with the cares of a growing family upon him, must drudge for years before he can secure a home, and yet there is in the South millions and millions of acres, areas that constitute an empire greater than Great Britain and Ireland, greater than the New England States with New York added, which, with a little expenditure, can be thrown open to the home settler and be made into happy and prosperous homes.

Now the same is true with reference to our timber. We thought that we had inexhaustible supplies of timber, that is, if we thought fifteen or twenty years ago about the matter at all. We had so much that the idea that it would ever be exhausted never occurred to anybody and it is only as we see it vanishing and see the time approaching when this will be a treeless country that we think about the limits of our supply. We are to-day in North Carolina cutting timber at a rate four times greater than God is making timber. Now, without any irreverence, it may be said that God is not making any more land. He is making more people, they are multiplying in the United States at a prodigious rate. When the war closed, forty millions would have more than covered our population; to-day twice that number will not cover it, but in that period of time no acres have been added to our domain, except those that we have purchased by conquest or with money across the seas. That condition remains unchanged.

Now, my friends, unless our activities as people are to be restrained or are to be arrested altogether, we have got to extend and conserve the materials which furnish the basis of our industries. If you want more farmers, you have got to supply them with the land. If you want to keep up your industries of which timber furnishes the basis, you have got to get the timber. You cannot make more lands, but you can make waste and useless lands, by the millions of acres that are now subserving no good purpose, available for farmers; and you can, by proper conservation of your forests, make them a permanent national source of wealth instead of a transient one, as will be the case, unless the present reckless waste is stopped.

Now, Mr. Chairman, I was very much interested in the discussion this morning by Mr. Wright of the plans adopted out in the States of Indiana and Illinois. I believe only a comparatively few years ago they had vast areas of swamp lands covered with water serving no good purpose for homes or agriculture. I believe, as a matter of fact, that to-day Indiana and Illinois have practically no swamp lands; all have practically been drained and within twenty years. I have read the plan outlined this morning and it is an admirable one. If our State Geologist can get the

people of North Carolina to adopt and put it in operation here in eastern North Carolina, this section of the State would blossom like a rose. Mr. Chairman, the problem is now just as pressing upon us as it was upon the people of Indiana and Illinois thirty years ago, and it is just as important that we should do it. The only difference is our lack of ability and, therefore, the Government of the United States can, I think, with propriety be appealed to. Just as long as there were cheap homes in the northwest for the farmer and the home seeker, we heard no demand for irrigation of the arid lands of the West, although we did hear speculation men talk about how fertile those lands could be made if some means could be discovered by which water could be distributed upon them. There was, however, no public demand for irrigation that forced recognition on the part of Congress until all the cheap lands in the central west and northwest were taken up and lands had become so high in those sections that they could not be purchased at a reasonable price; and the tide of immigration had pushed on to the border of this dry area. There was but one way to make that land available for homes and that was to put water on it. They came to Congress; they thundered at the doors of the House and of the Senate until they made the Democratic party and the Republican party and all the parties heed them, until they made the Treasurer of the United States open the vaults of the Government and take therefrom sufficient money with which to irrigate those lands, to make them available and fit for homes; in order that the home seeker in the United States might find, not a home, because he could find that anywhere in the northwest if he had enough money to pay for it, but a cheap home, a home within the reach of the poor home seeker.

The Federal Government undertook this work because it was too big for the individual, or because the individual could not be induced to do it in time for the needs of the Government to furnish homes.

Now, as I started to say, a little while ago, we will no doubt in the end, even if the Government does not give us a single cent, drain our swamp lands here in eastern North Carolina by the plan suggested by Mr. Wright; but that is not coming as quickly as I would like to see it come. I want to see the State in action, giving us an ample and effective law. I want to see needs arise so that the individual is ready to take the initiative and I want to see the nation come to the relief of the State and of the citizen by loaning them money, not giving it to them; for I do not believe in the Government's giving anybody money, but loaning it to them upon such reasonable terms that they can pay it without feeling it. We are now approaching a condition in the South with reference to our swamp lands

that was reached in the West with their dry lands, which ended in Congress passing laws favoring irrigation.

We have now reached the time in North Carolina when it is hard to buy land. You start to-morrow for the purpose of buying a home here in eastern North Carolina and you will find that unless you take one that is hardly worth having, you will have to pay a very high price for it, which is entirely too high for the ordinary home seeker such as I have been talking about; higher than could be paid by the immigrant such as has settled the great Northwest and made its land, in twenty years, increase from fifteen dollars and twenty-five dollars an acre, as Mr. Wright stated, to one hundred and fifty and one hundred and seventy-five dollars. Whatever may be said about certain classes of immigration, any man who will go out to the Northwest where the foreigner of the right type, the Dane, the Swede, the Norman, the Scotch and the German, have come and bought lands at cheap prices, such as we cannot give them to-day here in the South, he will abate his opposition to properly restricted and regulated immigration. Think about it, the influx of population drawn by those cheap lands, and they went further and further in order to get it, has raised lands in twenty years from twenty-five to one hundred and fifty dollars per acre!

We have got here in the South a larger area of waste lands than they have arid lands in the West, that are capable of being made productive. There are more acres that are available for farms in the South that are now under water or that are made useless because of too much water than there are dry arid acres that are capable of being made profitable for farming in the West. Think about it! Seventy-seven millions of acres of swamp and overflowed land, I believe Mr. Chairman, in the South that might be available for farming purposes! It is a vast alluvial empire, every acre of it richer than the richest of those arid lands of the West after water has been put upon them by the Government; richer (I believe I am justified in the statement) even than the lands of Indiana and Illinois, and with a better climate. The most valuable alluvial deposit upon the American continent is found right along here in this little strip of the Atlantic Seaboard, which we call the South. Seventy-seven millions of acres, a hundred thousand square miles, an empire I say in itself, and yet we find men here wanting farms. We find ourselves unable to furnish the immigrant with lands cheap enough to attract them, and yet we have this vast area of lands right at our doors richer than that which we have already cleared. We cleared in the high places; we cleared the weaker land because we could do it cheaper. The best, the most productive and the most wealth-producing still remains unused, and we ought to

start at once to try, by the methods that have been outlined, to prepare this land for farms as long as the demand may grow. Nothing would do more towards turning the tide of immigration to this Southern country than the knowledge that these vast alluvial deposits were to be made available for cultivation.

Now we are, I say, in the same condition that the West was when it demanded irrigation. We need this land in the normal processes of our development as a State and as a section of this great country of ours. Why should not the Government respond to this demand of ours? There is no difference between the proposition of irrigation and the proposition of reclamation. It is the same principle reversed; that is all there is in it. The lands of the West were worthless because of a lack of sufficient water. The swamp lands of the South are worthless for agricultural purposes because of too much water. One is a proposition which the Government is now working out, upon which it is spending millions to make the land profitable, to put water on it; the other reclamation proposition is to take off water which now makes the land unavailable for farming purposes. The principle is the same and yet there is a vast difference, not in principle but in the thing sought after, in the thing accomplished. When you drain an acre of arid land in the West, Mr. Chairman, you do nothing except make another acre of farm land, for it was a barren waste before the Government went out there to reclaim it; but in the reclamation of the swamp lands, much more is accomplished.

Along every swamp and every morass in the South there are settlers living on the rims or borders of the swamps, populous communities that are as effectively separated by the swamp in many instances as they would be by a wall one hundred feet high. It, therefore, interferes to a most serious extent with the construction of good roads and intercourse between people which goes to build up the material and the social status of communities; but, worse than that, they are the greatest menace to the health of the people of the South that they have to encounter. Sanitary conditions have been improved enormously throughout the South by sinking deep wells so as to get below these swamps' surface waters, but you can never hope to make the South as healthy and invigorating and as bracing as it otherwise would be as long as these swamps and overflowed places are permitted to remain in their present condition.

It is, therefore, a proposition of drainage, Mr. Chairman, of reclamation by drainage. It is not only a question of adding more acres of farming land to the country, but it is an immensely important sanitary question. It is an important question in regard to good roads, and it is also a forestry problem, but I do not want to go into that now.

Now, what have we got here in North Carolina? I believe they say we have got over 4,000 square miles of these swamp areas in North Carolina. That is about three million acres that might be added to the agricultural land of the State. It is better than any three million acres that you have got now, and it can be reclaimed at the expenditure by the individual, by the State and by the Government of a trifling sum of money compared with the increased enhancement it would make to the value of that land. I believe there is enough of this land within a radius of thirty miles of Newbern to furnish homes, if it were put in condition for cultivation, for at least 25,000 people. What good is it now serving, this broad expanse within that radius of thirty miles? It is nothing less, it is nothing short now of a nuisance, a breeding ground for mosquitoes, a pestilence serving no good purpose to the private individual who owns it and in many instances worthless as an asset to the county and State, and a menace to the health of the whole community. They are as great impassable walls separating and segregating the people of eastern North Carolina so that they are seriously hampered in social and business intercourse and trade that would be possible to them if these obstacles were removed, permitting the construction of good roads. It is possible to remove these obstacles and thus give to our people the same blessings that other communities enjoy.

Mr. Chairman, I ask pardon of the convention for having spoken so long and so disconnectedly. To tell the truth about it, I had a certain line of thought which my good friends took away from me, and during the dinner hour I had to sit down and revise my remarks and proceed upon different lines, which accounts for the rather disconnected way in which I have discussed the subject.

At the morning session, September 10, the first address was by Hon. Chas. R. Thomas, Congressman from the Third District.

ADDRESS BY CONGRESSMAN CHARLES R. THOMAS.

Every citizen of the State, as Mr. Small stated on yesterday, should co-operate in the improvement of our highways, good roads, also the waterways and public education, and also in this great drainage movement, because we have got a citizenship that in this day and time is progressing, that is making as rapid progress as any State in the United States. There were some fellows that used to say that North Carolina was a strip of land between Virginia and South Carolina, and it used to be called the State of tar, pitch and turpentine. It would be asked, what are North Carolina's principal products, and the answer would be tar, pitch and

turpentine. It is no longer a strip of land between Virginia and South Carolina. According to these figures taken from the Census Office report, it is one of the most progressive States in this entire Southland of ours, in which we were born and reared, and to which we are attached by the tenderest and dearest ties, and it is one of the most progressive States in the United States. Our people are getting more wealth, they are getting more refinement, and everything that goes to make a great State. Along all these lines of development North Carolina is making vast progress. With many industries yet undeveloped in the past decade in agriculture, in manufacturing and in everything that makes a State good and great. Let us in the next decade go still further forward until North Carolina beyond all question, having solved other problems, has become among the foremost States of the South, and of the American Union.

Now Mr. President, this convention is to inaugurate. We do not expect to do it in a day, a month, or a year, or maybe ten years. It took ten years to get the inland waterway. We are going to co-operate, the representatives in Congress, the citizens, and the Legislature, we are all going to co-operate in this movement. Of course there may be objections, and it finally rests with the Legislature, and with Congress and with the people. We understand that we are going to start this movement for the progress and the development of the great good of the whole commonwealth of North Carolina.

What is our object here to-day, on which we are concentrating our attention? It is well enough, as old Daniel Webster stated in one of his speeches, to state the object of this meeting. I have been talking about North Carolina. What is the object of this particular meeting here to-day? It is stated in this call issued by the State Geologist:

"At this convention plans will be considered for draining the swamp lands of North Carolina that will make it practicable for all owners of land suitably located for draining to carry out the drainage plans without any immediate outlay of money. In other words, the drainage of the swamp lands can be accomplished without its costing the owner any money except what he is able to derive directly from the land itself and due to drainage. It will represent money that it would be impossible for him to obtain out of the land under normal conditions."

As Mr. Wright stated yesterday, the State would lend the money to drain the swamp lands, and that in three years that you would raise on one acre alone enough to pay your drainage assessment. That is the object of the convention, stated in that call. It is not a gold brick, as it has been tested and tried for twenty years, in Illinois, Indiana and in another State, Iowa, Mr. Wright mentioned. He mentioned those three States in particular. He stated that in Indiana there were cess pools, and

they had what they called hog sloughs. There is not a single acre of undrained, undeveloped land in the State of Indiana to-day. It took twenty years to do it, but the whole State has been reclaimed, and he stated that he had never known any drainage loss, except in the case of non-resident owners to pay the drainage tax where the land was forfeited for the non-payment of the drainage tax. Here and now begins a movement in North Carolina to reclaim the swamp lands of the State, which will be by means of State and National laws, backed we hope and believe by public sentiment. We do not expect to do all of this at once. Rome was not built in a day, and in North Carolina as in other States, we are going to start and day by day and month by month we are going to try to develop this plan for the betterment of the conditions, especially as to waterways and good roads in North Carolina and the South. It is certainly worth the experiment. I met sometime ago Dr. Hannis Taylor, who has had conferred upon him the degree of Doctor of Laws. He was Minister to Spain under Mr. Cleveland. He was born in this State, and he lived, I think he told me, in the same brick house in this town in which the ————— now live, next to my house; that is where Hannis Taylor lived for a while, and he told me in a conversation that a Spanish diplomat had said that whenever Romero was asked to do anything that was difficult, he would say, this Spanish official, it is very difficult, but I will try, and when it was a thing that was almost impossible to accomplish, he would say, it is impossible to accomplish, but we will do it anyhow. That is the correct principle. I found out early in my career as a public man that the great thing in life was to try, if a thing is difficult, yes, if it is impossible, the thing is to try to accomplish it, and if you try, nine times out of ten you succeed. Even if the drainage of the swamp lands in eastern North Carolina seems impossible we can accomplish it; we can accomplish it by co-operation. My friends there is no great movement that the world has ever seen that has been carried to perfection, unless there was an effort made, unless you tried.

When I ran for Congress, the first campaign I made helped to win in the election, and this illustrates my purpose, otherwise I would not say it. I said to my opponent: "John, here is your record in Congress, here is what you have accomplished." And he said: "Well, it is a Republican administration and I could not do things." "Well," I said, "John, why didn't you try, why didn't you try"; and I said "if you did not succeed, try, try again," and the people took it up with a shout, and I have heard it in that county ever since. I go back there now, and they say, you told him to try, and that is the correct principle on which to proceed. That is the principle upon which we are going to proceed in this Drainage Convention. We are going to try to secure an adequate State law, and

we must have a National law to co-operate with the State law. Our idea has been to secure this legislation, and then it is up to the people to put the law in force. We are simply trying to inaugurate the movement. We are not insisting that it should be carried out, we will simply try to obtain the laws, and it is up to the people. We must have their co-operation to enforce the laws. The best experts say that drainage is entirely practicable, that the drainage of the lands of North Carolina would increase the permanent value enormously, from lands that are worth almost nothing now to lands that would be worth \$100 per acre and upwards. My friends, you remember the old Hines farm out here. I went out there one day, and I remember that it was out there that I smoked my first cigar, and it was impressed on my memory, and that land was worth then \$5 per acre, and now you cannot buy it at any price. It is now Oaks Farm, and on the early truck crops they make thousands of dollars every year.

I want to say here before I pass on, that I have no sympathy for a man who criticises experts. What we are spending for the army and navy, what we are spending for other government objects is a mere drop in the bucket. Experts' advice upon all matters affecting public interests is of the greatest importance in my humble opinion. There are some who depreciate expert advice; there are some who say it is extravagant. See what the United States is doing through that great Department of Agriculture, see what it is doing for the people through these experts. In my opinion it is one of the most valuable works of State and United Government.

Now we are not going to have anything but what you call a tentative law, that is the Legislature has to pass it. The Legislature represents the people, and they know what is needed, and in addition to the law passed by the State Legislature it would be advisable to have Mr. Small, Mr. Godwin, Senator Simmons and myself, and probably twenty-five representatives of the different States, go to Washington and advise with the Secretary of the Interior about what kind of a National law we should have. We thought that inasmuch as the United States was applying proceeds to irrigate the dry lands of the West, we thought we should have something applied to the drainage of the eastern lands.

One of the first bills that was introduced in Congress on that subject, and I have it here before me, was to drain the Dismal Swamp. They reported favorably on that bill, but they kicked terribly on it. (Bill is quoted.)

Now our whole aim and purpose in framing that bill was to frame a bill that would benefit the individual landowner. The irrigation law of 1902 provides to take the funds from the sale of public lands in certain States

which are named here in the bill that was framed. The bill I have here provides for taking the lands from all the other States which are not named in the Irrigation law. In our bill we only take the proceeds of the sale in those States which are not named in the Irrigation law. If it is fair for us to have their lands irrigated, it is fair for us to have our lands drained. In order to secure the best results we must have a State Drainage Law and the National Government in co-operation with the State. Unless we have the right kind of State Drainage Law, and the law that is proposed in brief, and very brief, is simply this, to have a number of landowners, a majority to rule. Then they can issue bonds, bonds to be paid off in installments, the first due in three years, and we should get a national law to co-operate with the State law. The money will be taken from the proceeds of the sale of lands and loaned for the drainage of these lands. This bill which we introduced is not perfect in my opinion, but we are going to perfect it in these details, and we are going to secure the co-operation of every section of the locality, and we are going to protect the State and the individual landowner. The drainage is to benefit the small landowner, and the man who has the small farm. With this good State drainage law as a basis, and with the national law, and I believe it is stated by Secretary Wilson's report that there are now one-half of the States of the American Union that have State drainage laws, so there could be co-operation between the State and the National Government. With this good State law passed by the Legislature in their best judgment, and this national law which we hope to perfect and pass, we feel sure that in the course of time we can accomplish this great work which will tend to the development of eastern North Carolina. As I stated before, we can only suggest and inaugurate this movement, and give you our best judgment, and it remains as to the final action with the Legislature and the Congress of the United States and to the people.

The next address was by Mr. E. W. Myers, hydraulic engineer, of Greensboro, N. C.

COST AND VALUE OF DRAINAGE.

BY E. W. MYERS.

Drainage is the process of removing superfluous water from land, whether this superfluous water is found on or beneath the surface, and as the object of drainage may be either for sanitary, road improvement, or agricultural purposes, the methods to be employed and the results attained will probably vary with the end in view.

While the especial reason for this meeting is the consideration of the problem of agricultural drainage as applied to swamp lands no presentation of the benefits to be derived from drainage would be complete without some brief reference to the other branches of the subject.

Sanitary drainage is a matter that affects in some way more or less directly the health and physical well-being of every citizen, and there are but few communities where general health conditions could not be improved by careful attention to the proper drainage of the vicinity; or if this end cannot be attained, then by the removal of all standing surface water at least. Sanitary drainage is beneficial in many ways, but probably its most marked effect is in the prevention or very great diminution of diseases of the malarial type and drainage less thorough than that usually necessary for farm purposes, will suffice for these purposes for it will serve to remove all standing water, so that mosquitoes are unable to find a breeding-place. A mosquito does not necessarily mean a case of malaria for not all mosquitoes can transmit this disease, though doctors are agreed that there can be no transmission of it except by this means. No mosquitoes therefore would mean no malaria. It is of course not possible to entirely exterminate mosquitoes throughout the world, but many places can abolish them locally, for unless driven by a favorable wind, they do not fly far from the place where they are bred; and drainage of all small pools and swampy areas within half a mile would under ordinary circumstances probably remove this source of annoyance and danger from any given spot.

The famed mosquitoes of New Jersey are actually in danger of becoming extinct in certain portions of that State because its citizens have resolved that they were not desirable inhabitants, and therefore in many places they have destroyed the breeding grounds by proper drainage.

In the great marshes near Rome it was first conclusively proved that malaria is transmitted by the bite of a certain species of mosquito. These marshes are now being drained, and as the drainage work progresses the very fatal malaria of that region is disappearing with the mosquito.

Proper drainage is one of the great factors which renders it possible for the United States to construct the great canal now being cut through the Isthmus at Panama. Now the death rate in the canal zone is no greater than that found among men similarly engaged here in the United States. Formerly the mortality was so fearful that it is said that every tie of the Panama railroad cost a human life, and almost the same might be said to have been the cost of every yard of earth excavated there by the French.

Agricultural drainage is probably as old as the art of farming. It has been the fashion for orators expounding the advantage of irrigation to point to its great antiquity and to show how the valleys of the Nile and Jordan were watered artificially in the earliest times of which we have any record. The art of drainage is of almost equal antiquity for in Greece at a very early period record is found of the reclamation of swamp lands by drainage. The earliest drainage project of any magnitude of which there is record was that for the reclamation of Lake Copias, a great marshy tract of 60,000 acres near Thebes. This same project has been orated in modern times and 20 miles of main canal, 2,000 feet of tunnel and a large dike have been constructed. At the outfall of the drainage channel there is a drop of 170 feet, which will furnish about 1,000 horsepower, and the water is then available for purposes of irrigation on the arid lands near the city of Authedon.

On the American continent the project for the drainage of the valley of Mexico is the earliest of which we have any definite knowledge. Here in the fourteenth century the Aztec kings built their city on an island in the lake and protected it by dikes of great magnitude. They divided the area which they drained into five districts so that the swamps were segregated about five lakes. These projects have been estimated to cover the whole valley of Mexico and have involved an expenditure to date of more than \$20,000,000 but the results have been more than commensurate with the outlay for a great area has been drained, freed from malaria, and made productive in the highest degree. Holland has been engaged in the construction of vast drainage works for several centuries, and a larger portion of this area has been reclaimed from the sea by the construction of great dikes. Gravity drainage is impossible over large areas and the water must be discharged by pumping, much of which is done by power furnished by wind mills. Great drainage works have been carried out in England too, in recent years, in the reclamation of the great swampy areas known as the Fens. These great projects have added many thousands of acres to the lands of these countries, and these reclaimed lands are now among the greatest producers of food products in the world.

Many drainage works have been undertaken in the United States by individuals, corporations, districts and States. Work has been done in Louisiana near New Orleans, in Florida in the Everglades, in Minnesota and North Dakota, in Indiana and in California. There is a State Drainage Commission in Minnesota with a generous annual appropriation, which is expended through the medium of a drainage engineer in the actual construction of ditches, while swamps have been made for the drainage of nearly the whole of the upper portion of the State. Many miles of canals

have been located through the whole of the Red Pine valley and a number of miles have been constructed.

In California, the State has been engaged for a number of years in studying projects for the drainage of the tule land in the lower Sacramento and San Joaquin valleys. These lands are so situated that gravity drainage by ditches has been found impracticable and the reclamation is by the construction of levels and the pumping of the enclosed and some of the works are of great extent covering from 17,000 to 60,000 acres and involving expenditures ranging from \$15,000 to \$1,250,000. The total expenditure in the district has been about \$17,000,000, and projects are now being worked out for the expenditure of many millions more.

Some work has already been done in the drainage of the Everglades in Florida through grants from the State, and more is in progress. The United States Government has recently shown a disposition to aid in the reclamation of swamp lands by drainage, through the Division of Irrigation and Drainage Investigation. This Division has been examining swamp areas, and has prepared plans for the drainage of several different kinds of swamps, as examples for the neighborhood. An instance of this is a complete survey of the west side of the Red River valley in North Dakota, and the preparation of plans and estimates for the complete reclamation of the swamps of the need.

Work has also been done in the vicinity of Charleston. Several bills have been introduced into Congress having in view the construction of drainage works of the Federal Government, one providing for the drainage of the Dismal Swamp, another for the drainage of the swamp lands of Minnesota, while others provide for the establishment of a drainage fund and the construction of works for the reclamation of swamp and overflowed lands in all the States. All of this work is projected because it is recognized that in most of the humid States the greater portion of the naturally drained land is already in cultivation, and while there are possibly 12,000,000 acres of good land in the arid States that may be brought under irrigation within the next twenty-five years, demand more than keeps pace with the supply. In the United States there are more than 80,000,000 acres of swamp or overflowed lands of which probably one-half are susceptible of reclamation by drainage, and at a less average cost per acre than is necessary to irrigate the western lands. In this State alone there are probably more than 2,000,000 acres of land in our swamp areas and if one-half can be disused, then one million productive acres can be added to our farm lands, or more properly speaking to our garden weeds, for by far the greater portion of this land is located in the market-gardening, truck-growing section of the State.

Figure for a minute what one million productive acres would be worth to the State. Divided into farms of 40 acres each, they would furnish support for at least 25,000 families and would add probably in excess of a million dollars per annum to our resources.

These acres are, however, idle and unproductive and to fit them for production they must be drained, when they will become capital yielding larger interest to those cultivating them. The soil is the farmers' business capital. He exchanges a certain sum of money for it or comes into possession of it by inheritance, and to its products he must look for the returns from his investment. He must solve the problems of its culture, for on the correctness of his solutions depends profit or loss. One of the well-recognized means of bringing about this result and making the farm pay is to remove the surplus water from the soil.

Superfluous water, or water in excess of that required for the best growth of plant life of commercial value and importance is due primarily of course to the rainfall either on the affected area or on areas tributary thereto, and this condition of soil may be either temporary or permanent. If it is a temporary condition, then there is a certain amount of natural drainage, sufficient in ordinary times and under ordinary conditions to take care of the precipitation; if the condition is permanent, as it is in certain areas, among which are the areas which are termed swampy, then the natural forces which tend to remove superfluous water from the land are for some reason impeded in their action. In either case, artificial drainage is the remedy for the condition. These permanent swampy areas are so for one of two reasons: the lack of drainage may be due to the fact that the general elevation of the surface is so nearly that of some nearby stream or other body of water, that there is no natural point of escape for the water standing on the lands or imbedded in the soil spaces. This is a not uncommon type of swamp in this portion of the State along the rivers, and the drainage of such areas would require special means.

A more common type of swamp, however, is that in which the general elevation of the surface is sufficiently above the water level in its natural outlet to permit of ready drainage, but this does not take place naturally because the small surface drains and channels are so choked with vegetation as to pond the water over the land, and thus a more or less constant water level may be maintained in this country of abundant rainfall, or if at times water does not actually stand on the surface, still such lands are more or less thoroughly saturated at all times and cannot be cultivated. In some instances there is no natural drainage channel for a swampy area, in which case the surplus water from the rainfall must collect in the lower portion of the basin until the demands of plant life and the amounts lost

by seepage and evaporation balance the inflow. Whether this condition of superfluous moisture is temporary, as in many lands or permanent as in the swamps and swampy areas, the same general method of treatment would be applicable. Every drainage project is an assistance to nature, and all drainage construction, to be successful must follow the lines laid down by nature. Water under the action of gravity tends to flow from a higher level to a lower, and man aids nature by providing channels along which this flow can take place. A greater or less number of canals, ditches and drains are constructed starting from some point where the water can be delivered, usually some stream, and reaching out to all portions of the area around, and so distributed and so constructed as to depth, width and grade as to remove the undesirable water from the soil. The whole work, to be successful, should be adopted to accomplish this result at all times and under all conditions.

The other possible method is in the ultimate reverse of this, the main drainage being from a land level to a higher, and in this case of course mechanical means must be provided sufficiently powerful, to elevate the necessary quantity of water to the desired point of delivery, while there are areas within our borders which are so situated as to render this mode of drainage the only possible one. Certainly there are none which it will be economically possible to treat in this way, though given the condition of a timber area and a congested population such treatment may become a highly profitable enterprise. In any drainage project the essential feature to be considered is the matter of cost. The benefits to be derived from it must be sufficient to outweigh the cost of carrying out the work. What will it cost to reclaim the land and what will it produce when reclaimed and improved; all questions to be solved. That the cost of the improvement must not be greater than the benefit to be derived from it is a maxim of the drainage laws, as well as in the conduct of ordinary business. Therefore, the first question to be answered in regard to any drainage scheme is "will it pay?" not in pleasure or satisfaction, but in dollars and cents.

As a general proposition the question may be answered in the affirmative, but in any particular case it cannot be answered until the cost of the proposed work has been closely estimated and balanced against the increased value of the affected lands. Neither of these can be determined without a careful and comprehensive examination of the area in question for the cost of the necessary improvements depends entirely on local conditions and each area presents a problem of its view.

The end to be accomplished is the removal of all water not needed to grow crops, but the means whereby this end may be attained will vary very

greatly with different areas. In some countries a single ditch has been known to drain well land for a mile on either side of it, while in other conditions a line of drain tile every 50 feet may be necessary to produce the same result. In the first case the cost may be less than \$1 per acre, while the cost of thorough tile underdrainage under average conditions may be from ten to twenty dollars per acre. Just what the cost will be can only be determined by investigation.

After having arrived at the probable cost of the work, it will be easy to estimate the increase of crops by comparing the acre to be drained with one which is naturally drained and whose productive powers have been well ascertained, in case the improvement is to be made on lands already wholly or in part under cultivation. If the area to be drained is not in cultivation the value per acre after draining may be estimated from the value of drained lands in the vicinity of these or any such. In regions where much drainage has been done the condensed evidence upon the subject of profit is that draining pays from twenty-five to fifty per cent annual profit on the investment. The profits accruing from the drainage of fertile land are of two kinds: first the increased yield of the commercial products of the soil, which has a direct money value to the producer, and second, the increased healthfulness of the community where drainage has reclaimed the waste land. This has a money value which is unquestionably very great, but which it is exceedingly difficult to measure. It is to be regretted that there are no home statistics from which these statements may be illustrated. Some years ago an investigation was made by the Bureau of Statistics of Indiana to determine the influence of tile drainage on health and crops, and a single township of the State was selected. Where drainage was one of the marked improvements, and covering a period of five years after most of the townships had been drained by consulting farmers who lived in the township during both periods, it was discovered that the average crop of wheat in the five years before drainage was $9\frac{1}{2}$ bushels per acre while the same land, after drainage, for five consecutive years produced an average of $19\frac{1}{4}$ bushels per acre. The average yield of corn for the first five years was $31\frac{1}{4}$ bushels per acre while the average yield in the five years after drainage was $74\frac{1}{4}$ bushels per acre.

The physicians of the townships were asked to report from their books, and it was found that in the first five years there had been 1,480 cases of malarial diseases while in the second period there had been 490 cases.

From these facts it seems certain that drainage has greatly increased the health and wealth of that community and thereby added materially to the wealth and prosperity of the State. The universal productiveness of the lands may be ascribed to the following effects of the drainage.

One of the changes produced by relieving the ground of its surplus water is increased firmness, which facilitates its culture, and also incidentally makes better roads through the region. The fineness of the soil is also increased by the percolation of water downward from the surface; permitting air and frost to more thoroughly disintegrate the soil particles, reducing their size and increasing the capacity of the soil for capillary moisture, making it more capable of resisting drought.

Drainage admits of earlier and more timely cultivation in many localities. The excess of water has been removed from the soil and the water passes down admitting warm air and fertilizing rains to such an extent that the surface is well prepared for the crops requiring early planting much sooner than wet soils. This is of great advantage not only to the seasons' work, but often makes the difference between an excellent and profitable crop and a poor one.

A certain degree of soil ventilation has been found essential to bring heavy lands to the highest stage of productiveness. When the level of the water is lowered, the roots of plants penetrate more deeply into the soil and as they die and decay an intricate network of minute channels is left, extending to the surface through which air circulates. The soil spaces being relieved of water are filled with air, which carries with it the fertilizing gases it contains furnishing oxygen to the roots of the plants and for the support of soil bacteria which are now recognized as playing such an important part in the conversion of the vegetable matter of the soil into nitrates. These elements of fertility are absorbed by the soil and held in readiness for the plant roots. These processes are continuous and play an important part in the productiveness of soils. In other words, well-drained soils do not become exhausted as soon as undrained ones where no fertilizer is used.

Drainage increases the temperature of the soil since a soil cannot become warm until the water on its surface is evaporated or thoroughly warmed by the sun. Since a large amount of heat is required in evaporating the excess of water, it is evident that to drain the surplus water away rapidly rather than hold it there until it has time to evaporate must greatly aid the warming of the soil. Experiment has shown that soils after drainage will be from 5 to 10 degrees warmer than they were before under the same extreme temperature conditions. Drainage also prevents a waste of fertility through surface washing since the object of all good drainage is to remove the surplus water through the soil instead of over it, preventing the washing away of the fine soil particles which

constitute its richest part. A drained soil becomes renovated, opened up to the full depth to which it is drained, an additional field being given to the plant roots from which it draws nutriment. A drained soil resists drought better than one not drained for the additional fineness of soil produced makes it capable of returning a large amount of capillary water and the greater depth of soil from which the plant roots can draw sustenance, both contribute to the power of a drained soil to resist the effects of a protracted dry spell during the growing season. Having said this much on the general question of drainage, it remains to consider the concrete question of the possibility of the profitable drainage of our swamp lands. The question is again that of cost and so far as the State lands are concerned, the possibility of disposing of them at a profit after they are drained. Some lands which are unproductive before drainage are equally so after it, though such cases are very uncommon. The question "will it pay?" can only be answered definitely after an investigation is made for the purpose. We know, however, that no better lands in other States have been drained and are now very valuable farming lands, and there is no evident reason why these lands should not become valuable farming lands also. Nor does there seem reason to believe that productive drained lands situated as are our swamp lands cannot be sold for a price sufficient to pay a handsome profit on any probable cost of improvement, for all over the United States there is a great and a growing demand for good land. Our population is growing at a rapid rate, and more acres each year are required to produce the needed food and clothing. Productive lands must be made more productive, waste lands must be brought into use. Out in the arid West the Government, great corporations and private individuals are spending many millions of dollars to bring needed moisture to enable land to be successfully cultivated. The actual expense of these undertakings range from \$25 to possibly \$100 per acre of land which will receive water, but farmers are glad to pay these prices for the water in addition to the cost of the land because the lands are productive and they can so use them as to pay a large return on the amount invested.

The area of these lands is limited and the only other source from which the needed agricultural lands can be had is the reclamation of our swamps. It is not probable that the cost of draining them will ever be less than it is now, so at its best let us look into the matter.

The drainage of swamp lands and its relation to public health was ably discussed by Dr. Francis Duffy.

DRAINAGE OF SWAMP LANDS AND ITS RELATION TO PUBLIC HEALTH.

BY DR. FRANCIS DUFFY.

Gentlemen.—I will endeavor to address you on this subject as requested, briefly.

The drainage of swamp lands, from a sanitary standpoint, means chiefly what is meant by the breaking up of the breeding ground of mosquitoes. It does not mean that only. Take the subject of tuberculosis, a subject that is occupying a great deal of the attention of the world, now, especially in all sanitary circles. As the general health of a community is improved by drainage or anything which affects, for the better, soil and atmospheric conditions, so much the greater resistance is offered against this disease, the germs of which sooner or later find lodgment in the bodies of most individuals. The death rate from tuberculosis shows that of all deaths, one in every ten, or some say one in every seven, is from tuberculosis. Think of that, all the wars, all the diseases of little children, typhoid fever, Bright's disease, malarial fever, railroad accidents and every other cause of death, still, this single disease, tuberculosis, is able to claim so large a share of victims. The thing is startling, the general public does not realize it. If they did, there would be very much more attention paid to the prevention of tuberculosis. Certainly, no individual would be so unmindful of his own interests and that of others as to neglect a subject of such vast importance. Now, the drainage of swamp lands has only that relation to tuberculosis as far as I know. Swamps do not breed the germ, which is as definite in its position and character as the germ of corn, and produces its kind as the grain of corn. But, like the grain of corn, it has got to have suitable environment. Corn will not flourish in dry places without moisture; it will not grow on stones. When we have excessive moisture we have one of the favorable conditions for disease.

Passing from tuberculosis, we have to consider the mosquito as a cause of disease, swamp grounds being breeding grounds for mosquitoes. There are a number of varieties of mosquitoes and several diseases which are known to be produced thereby. Perhaps, there are more that have not been discovered, for it seems that nearly every year something more is found out. Our text books, until recent years, had no mention of the relation of the mosquito to malarial fever, which claim so many victims every year. Malarial fever is produced by a certain kind of mosquito, the *Anophele*, which is not the most numerous variety. This mosquito breeds in stagnant water, bites an infected subject, sucks the blood and thereby becomes the intermediary host of the malarial germ, which after a brief period of

development, is capable of being injected by the bite of the mosquito into the body of another victim, causing some variety of malarial fever, according to the specific nature of the germ. A single bite may cause infection. This is a night mosquito and does its mischief from sundown to sunrise.

Elephantiasis, a disease of tropical climates, sometimes occurring in this neighborhood, is one to which the mosquito stands in causative relation, in at least a considerable number of cases. A parasite, the *filarie sanguinis hominis*, having gained access to the human body may be taken in by the mosquito and water polluted which, being drunk, causes infection. Possibly, the mosquito may inject the germ directly. As no particular mosquito has been named in this connection, it is likely that our very numerous culex is able to do this mischief, provided only, it first finds a diseased subject to feed on. This disease is characterized by an enormous enlargement of a limb or some other part of the body, the lymph channels being occluded at points below which they are distended.

At least thirty years ago, I was consulted by a man who said he had been stung or bitten by something. The limb began to swell, and took on a character I had never seen before, nor have I seen such since. It was not an ordinary inflammation, but the part became so swollen and ulcerated that it had to be amputated. Going to Philadelphia, later, I exhibited it to the Pathological Society, which was then in session. It was thought to be a case of Elephantiasis. It may have been that the man was bitten by a mosquito.

Then again, there is the yellow fever mosquito, the *Stegomyia*. It is not so much an animal of the swamps, which, however, stand in some causative relation to its existence. In the language of a Marine Hospital bulletin, they might almost be called domestic animals as their habitation is usually about the house and chiefly in towns. Yellow fever is caused by their bites when they have previously been infected by a diseased subject. We know something of the ravages of that scourge and the importance of anything which will prevent it. Now, the most harmful mosquito is the one that breeds in stagnant places; it scarcely breeds in running water but in these stagnant places, many of which may be drained, this mosquito breeds in great numbers. Sometimes when I have spoken of the mosquito theory, when I have had opportunity of talking about it to the laity, persons have scoffed at the idea of such a thing being possible, stating that they would all have been dead long ago. But one may be bitten by the dangerous mosquito but if it has not already become laden with the dose from some infected person, it will not infect the person bitten; but a subject which is infected is capable of conveying it to others through this mosquito. Not many years ago, I was called in consultation in the

night to a man who was dying of hemorrhagic malarial fever; he had recently married, having a wife and one child. I realized that that man, like many others, was as surely killed by a mosquito as if he had been bitten and killed by a rattlesnake. A very short time after that I was called to see his child. The child and the widow presented a sad picture. I prescribed for the child and started away. There was a pond near the house and I noticed that it was discolored. I turned back and spoke to the people near the pond and asked why they allowed such a thing to exist and to breed mosquitoes, and spoke of the damage which had been done as there had been a number of hemorrhagic and other forms of malarial fever in the neighborhood. The lady said, "I wish you would speak to father about it, for he does not seem to think that it does any harm." That man is one of the most intelligent in a community of intelligent men. It is only a question of ignorance of a subject, not generally understood, outside of medical circles; otherwise, people could not be so unmindful of their own welfare. When I look around at this convention, seeing so many gentlemen here whose general knowledge of the world makes them conversant with things discovered, I felt that they knew about as much about it as I do, and it was hardly worth while for me to talk to them on these lines; yet, only last summer I met a gentleman who has occupied a high place in the councils of the nation, and, he has been governor of a State; and I began talking on lines that I am now talking on and he told me that he did not believe a word of it. He said, "How do you ever get it? The mosquito has got to bite somebody who has got malaria, and an infected person must get it from the mosquito." And it did look to the bystanders as if he had me cornered. I replied, "It is like the egg and the hen. Which started first; was it a special creation or an evolution from some other form of life? It is possible there may be lower forms of life under such environment that one form may change to another. Spontaneous generation has never been known to occur. We know that the malarial germ exists and people are foolish to doubt its existence because we cannot trace the origin. The cause of malarial fever has been demonstrated thoroughly; persons have been taken, who were healthful, and kept under wire screens on dangerous marshes, and they remained healthful, and other persons have been exposed outside of the screen, and they were promptly infected with malarial fever."

In North Carolina great advances have been made in the enactment of laws for the protection of the public in relation to the practice of medicine and in the direction of sanitary improvement. Small appropriations have been made for the maintenance of a Board of Health and of laboratories. Bulletins are issued by the Board of Health and something has been

learned from this source by some people, but it is a slow growth. Sometimes a bulletin goes out relating to typhoid fever, which is claiming its thousands all over the country, and sometimes of tuberculosis, and at other times relating to other important subjects.

I suppose these bulletins are noticed chiefly by the medical profession. But the general people have more need of them and ought to get them. They ought to go in the homes of the families. If enough money has not been appropriated to put them free to everybody, then enough should be appropriated. As far as the doctor is concerned, the conscientious man is continually doing a sort of missionary work, teaching the people along these lines at his own expense. Why should not the people take more interest? Few are so ignorant and so callous as to have no interest in stopping sickness, but there is comparatively little interest now among the people on whom it seems a sanitary era is about to dawn.

I saw two men in my office recently, both of whom came from a neighborhood where typhoid fever was prevailing. I felt it was my duty to warn them against flies and infected wells as causes of typhoid and I did so with some carefulness. One of them was silent, the other said, "Well, whenever I get thirsty, I drink water wherever I can get it." And that is about so. You may take that as an illustration of the general knowledge of the people about these subjects. I don't think there is anything that the people of the country could be interested in which would be of more advantage to them than to learn to protect themselves along the lines of sanitary science. Speaking with a health official several years ago on the subject of preventable diseases and their ravages, I remarked, that if a ravenous beast went daily from county to county devouring a human victim every day, getting three hundred and sixty five per year, the people of the State would spend, if it were required, an enormous amount of energy and capital for his destruction. But such insidious scourges as tuberculosis, typhoid fever, malarial fever, hook-worm and other cripplers of the body, and destroyers of life, though claiming ten times as many victims, excite but little alarm and cause but little outlay, except that which is forced on the victim and his family. Instead of being regarded as the impositions of faulty sanitation and environment, they are considered more as inevitable natural events or the mysterious dispensations of a Divine Providence. Recent newspaper correspondence from Africa tells of the desertion of several villages because a few of the natives were killed by lions. When I saw this, I remembered my conversation with the health official. The physician reaps his harvest of dollars when disease runs riot, but the average doctor is not on so low a commercial plane as not to willingly impoverish himself if thereby he could abolish disease.

Nor, need his occupation be gone, but rather changed in the fight for prevention, rather than attempts at cure. But, do not dishearten him with indifference, suspicion and parsimony. The American Medical Association is now moving, through the ramifications of its organization, to create a department of public health in the National Government. Our National legislators will be confronted with this subject. Let them give it their earnest consideration as of more importance than the strengthening of party lines, or of almost any measure which may be submitted to their judgment. Our worthy politicians are not only popular leaders but are followers of the populace. If we can disseminate and create a demand in the homes, all that can be accomplished by legislation will soon be enacted.

In response to a request from Mr. Small, Dr. Caton of Newbern made a few remarks on this same subject.

Gentlemen.—I do not know that I can add anything to what Dr. Duffy has said, as he seems to have covered the ground pretty well so far as malaria is concerned. I observed one thing, which I do not know that he has mentioned, and that is, that the most severe types of malaria are found chiefly among the poorer class. I presume that may be because they screen less than the better class. I have been practicing now for ten years, and, with the exception of one year, my practice has been in eastern North Carolina. I have seen comparatively few cases of this severe type of malaria among the better classes. The type of malaria that Dr. Duffy referred to more especially appears every other day, sometimes every day. There is one which the doctor did not touch upon and that is the hook-worm disease. After malaria, I believe it is the most important disease that we have to deal with in eastern North Carolina, and in the eastern sections of other States. We know these cases. They are what people fifteen or twenty years ago called clay-eaters. In boys and girls anywhere from six to eighteen years old, you recognize the disease by the bloated and very pale expression. This disease is caused by a little worm. It is usually about one-half inch long and curved at one end which gives it its name.

We think that these cases are certainly all gotten from shallow water. We do not think that they get it from deep wells. Of course the surface water drains into these shallow wells and carry off these little worms, and these eggs develop into worms and the people get them from the water; or, if they are not developed into worms, they swallow the eggs. I think that is one of the most important diseases and it is one which can

be prevented by deep wells, and that may be taken up by Dr. Lewis. I think we should have these little pamphlets distributed among the laymen.

The next speaker was Hon. H. L. Godwin, Congressman from the Sixth District.

ADDRESS BY CONGRESSMAN H. L. GODWIN.

Mr. Chairman and Gentlemen of the Convention:

It will be impossible for me to say as much upon this important subject as I would like to in so short a period; but I am indeed glad to be here to-day at the first North Carolina Drainage Convention held in Newbern, historic old town of Newbern, because I believe, gentlemen, that this convention dates the beginning of one of the most important projects to the people of our State. I believe, as we go forward, as we will certainly do in the future, and develop the project of the drainage or reclamation of swamp lands, as we will; and, as we have succeeded and accomplished other wonderful undertakings for the State of North Carolina, which we are proud to boast of, which have made North Carolina what she is to-day, I believe as we look back ten years hence, we will see that this convention will go down in history as one of the most important meetings in our State. I cannot add much to what my colleagues have said; neither can I add anything to the medical expert testimony and other addresses that have been delivered here, but I want to say that, if we will go forward in this movement with the determination to succeed, we will succeed and we will be strong and gather strength in our undertakings. It is well that we should meet here to-day. It is a wise step that the people who are interested in the great question of drainage has taken and the people of North Carolina are to be congratulated upon this meeting held here yesterday and to-day, and if Dr. Pratt wants to know how much we are interested in the subject of drainage, I want to tell him and tell you that immediately upon getting information that the State Drainage Convention would be held here, and that Mr. Wright, the expert drainage engineer upon this important subject, would be here to-day, I communicated with the Department at Washington and secured the services of Mr. Wright to accompany me, beginning with to-morrow, through my district, to address several large farmers' meetings in the various counties of my district. We are not only interested in the subject of drainage, but we are interested in all other subjects that will naturally come after we have achieved the reclamation of our swamp lands. Then we will have the proper conditions in our rural districts that the country people are entitled to to-day, and have been entitled to in the past. Talk about the

farmers having to move to town to send their children to the graded school! Why, the man in the country is as much entitled to a good graded school as the man in the town and, whenever the farming people of North Carolina, whenever the people who live in the country and on the land that produces the wealth of the country, come together and study these vital questions like the merchants and others study their callings, then the reclamation of swamp lands will be an easy matter.

Mr. Thomas said it would require co-operation. That is true. Mr. Thomas said it would require actual work, and this is true, but it will require the actual work and co-operation of the farmers of this State. Your representatives in Congress are heart and soul for the project. The representatives that you will elect to the next General Assembly of North Carolina will be as one man for the drainage of the swamp lands of the State, but they are not going to act. A public servant is slow to act until he has obtained the will of the people and the thing for the people who are interested in drainage to do is to come together and express their desires and determination to have their lands drained. I have not been in Congress as long as Mr. Thomas and Mr. Small, but I have been there long enough to know that whenever a representative in Congress ascertains that the people of his district are down behind him on a certain proposition, you will see that representative begin then and there to do everything in his power to secure that measure. Meet together on this question as the people of the State meet on other questions. You take lawyers and they meet annually. What for? They meet to study questions concerning their interests. You have heard the physicians who addressed us this morning talk about what they did in their Medical Conventions, what resolutions they passed, what discussions they had with reference to public interest and concerning their own welfare. Take the manufacturers, the men who are engaged in the manufacture of furniture or any other article, and you will see them attending the Manufacturers Association. What is the object of their coming together and studying questions concerning manufacturing? It is to find out and ascertain how to produce that manufactured product with the least cost possible. The grocers, the cotton spinners and men of almost every calling and profession of life meet together sometimes annually and sometimes monthly and sometimes more often than that to discuss and study questions which relate to the business in which they are engaged. It is the duty of the people of North Carolina, if they are in earnest about the drainage of our swamp lands, to come together as one man and stand together and petition the Legislature and Congress for adequate laws for

drainage and for assistance, setting forth in that petition these desires and petition what they are going to have and there will be absolutely no doubt about the results.

Is drainage necessary? Who will deny it. Where will you find a man anywhere who will deny that it is an absolute necessity? Will the swamp lands of North Carolina produce well? Which of the lands of your State will produce more corn than any other? It is a fact that cannot be contradicted, a fact that has been found to be true in the U. S. Department of Agriculture that the lands of North Carolina will produce as much corn to the acre as the reclaimed lands of Illinois and Indiana. You have heard these physicians say here that it is absolutely necessary to drain the swamp lands from a standpoint of public health. Lay aside agricultural purposes, if it is necessary to drain the swamp lands from the standpoint of inducing better health, then it is the duty of the State to drain the swamp lands, but that is not all. The richest, the best, the most fertile soil that we have anywhere within the boundaries of our State to-day are in these swamps, fit for nothing, absolutely available for nothing, except timber purposes. What are we to do? Are we to remain idle when we are made conscious of the fact that it is necessary to drain the swamp lands from a standpoint of public health? It is a necessity from the standpoint of the population of the country. Every year we have landed upon our shores one million immigrants, to say nothing of the ever increasing population within the borders of the United States. We are increasing our population daily and we are not making a single foot more land. It is a duty that you people owe to the citizens of the country to make more homes for the people and thus build up the State. It cannot be denied that the swamp lands of North Carolina will be valuable for trucking purposes, and by their reclamation thousands and thousands of dollars would be produced every year by the truckers.

If we agree upon the fact that swamp lands should be reclaimed, then the question is how can we secure Federal aid or State aid to reclaim the swamp lands. We have a precedent for it. The Federal Government has gone out West and irrigated the arid lands of seventeen States—lands in the western portion of this great country that were almost worthless and unfit for use. Now, we contend that if the Government of the United States will furnish money for the Western States to irrigate those lands where there is not enough water, it certainly becomes the duty of the Federal Government to come to the eastern section of this country and drain the swamp lands where there is too much water. I would not undertake to offer any expert testimony, but any man with any sense can tell you that it is an easier matter to get water off of land than to get

water upon it. It will be an easier matter to drain the lands of the eastern section than to carry water to those lands in the West that are too dry.

One of the most valuable and impressive talks of the convention was by Mr. John A. Wilkinson of Belhaven, N. C., who told of practical results obtained by his brother, S. W. Wilkinson, and himself in the drainage of certain lands in Beaufort County. The substance of his remarks are about as follows:

About five miles southeast of Pinetown, Beaufort County, a canal has been constructed through one of our large swamp areas for a distance of five miles and having a width of 30 feet and depth of seven feet. Before this canal was begun, the people living in the vicinity of the swamp all claimed that it would be impossible to drain the swamp as there was not sufficient fall to take care of the water. The ones who were interested in the project, however, have had a survey made of the swamp and were confident that there was a sufficient fall along the line of the canal to take care of all the water and drain the land. As the canal was being constructed, it was found necessary at the end of a mile and a few years to construct a retaining dam six feet high in order to keep sufficient water in the canal to float the dredge. After another mile and a quarter of the canal had been constructed, it was found necessary to build another dam six feet high. After the five miles of canal had been constructed, the total fall in that distance of fall was found to be a little over 12 feet. The dredge was then taken back down the canal and the dams removed. During the extreme heavy rains of the past summer in eastern North Carolina, this canal was able to take care of all the excess water, and, as far as I could ascertain, it never rose over 15 inches in the canal. Last spring, in order to determine the actual agricultural value of the land drained, ten acres bordering on the canal were cleared by cutting down the trees and underbrush and burning them up, leaving the stumps. Corn was planted by means of a hand-drill made out of a piece of hollow gum wood. There was no opportunity for plowing the field, so the corn was planted by simply running the drill into the ground and dropping the seed. It was also impossible to cultivate the corn as it was growing, on account of the stumps. The fires, however, had destroyed all of the undergrowth so that there were no weeds to interfere with the growth of the corn. This tract produced an average of 40 bushels of corn to the acre, and this will give an idea of the great value of this land for agricultural purposes. With

the construction of lateral canals, this main canal will be capable of draining from about 6,000 to 7,000 acres. Another advantage gained by the drainage of these swamp lands is the construction of a good system of roads along the banks of the canals. In connection with the canal just referred to, a road-bed has been made along the line of the canal.

At the close of Mr. Wilkinson's talk, the Chairman read the following telegram from the Greensboro Chamber of Commerce:

GREENSBORO, N. C., September 10.

JOSEPH HYDE PRATT,

Drainage Convention:

A cordial invitation is extended to attend Good Roads Congress, Greensboro, N. C., October 13, 1908.

CHAMBER OF COMMERCE.

REPORT OF COMMITTEE ON RESOLUTIONS.

The following report of the Committee on Resolutions was read and unanimously adopted by the convention:

I. WHEREAS, On account of the importance of the subject of drainage to the welfare of North Carolina, your committee resolves that it will be to the benefit of the people of the State:

First: That the Drainage Convention affect a permanent organization to be known as the North Carolina Drainage Association.

Second: That Mr. John A. Wilkinson be elected president of the Association. That Dr. Joseph Hyde Pratt be elected permanent secretary-treasurer of the Association. That the following vice-presidents be appointed, one for each county: P. H. Morgan, Currituck; F. F. Cahoon, Pasquotank; J. H. Small, Beaufort; W. S. Davenport, Washington; A. B. Croom, Jr., Pender; J. J. Wolfenden, Craven; E. M. Koonce, Onslow; John C. Parker, Jones; W. S. Chadwick, Carteret; J. T. Butler, Columbus; P. Rourk, Brunswick; S. S. Mann, Hyde; O. L. Clark, Bladen; J. A. Brown, New Hanover; Dr. H. C. Lilly, Cumberland; W. G. Ferebee, Camden; E. W. Myers, Guilford; D. M. Patrick, Greene; and in addition to these that Messrs. J. O. Wright and C. R. Vandecarr be appointed vice-presidents at large, and that others can be appointed at the discretion of the secretary.

Third: Officers shall be elected annually at the yearly meeting.

Fourth: That any one interested in drainage may become a member of the Association by the payment of \$1 annually to the secretary-treasurer for dues—and that donations to any additional amount will be accepted by the Association to promote the cause of the Drainage Association.

Fifth: That any one interested in drainage shall be permitted to attend the meetings of the Association and to take part in its deliberations.

Sixth: That the president, secretary-treasurer and any three vice-presidents shall constitute an executive committee.

Seventh: That there shall be an annual meeting held once each year on the second Wednesday in September, the next meeting to be held at Newbern, N. C., and special meetings shall be called at any time and place that the Executive Committee may deem advisable.

Eighth: That the Executive Committee appoint a committee to secure appropriate legislation and to attend to all matters affecting the welfare of the Association. That the Secretary of the Association be Secretary of this committee, and that the President be an ex-officio member thereof.

II. WHEREAS, Mr. J. O. Wright has shown the keenest interest in the reclamation of the swamp lands of North Carolina and by his untiring efforts and assiduous labors has done so much to make the people of our State realize the absolute need for proper drainage, and is largely responsible for the gathering of this convention;

Resolved, That the unanimous thanks of the convention be tendered to him as a due expression of our appreciation of his labors in this cause.

III. WHEREAS, The municipality, people and newspapers of Newbern have extended to the Drainage Convention the kindest welcome and the most enthusiastic support as shown by the cordial welcome delivered by Mr. M. H. Allen, on behalf of his Honor, the Mayor of Newbern, by the presence and interest of the citizens at the several meetings of the Association, and their bounteous hospitality, and by the editorial expressions contained in the newspapers,

Resolved, That the unanimous thanks of the convention be tendered to the mayor, municipality, citizens and newspapers as an expression of our appreciation of their efforts in our behalf.

IV. WHEREAS, The Drainage Convention is indebted to the courtesy of Sheriff Biddle for the use of the court house as the place for its meetings,

Resolved, That the thanks of the convention be tendered to Sheriff Biddle and to the people of Craven County for their bounteous hospitality.

V. WHEREAS, The efforts of Joseph Hyde Pratt, State Geologist, and the Geological Board, of Senator Simmons, Hon. J. H. Small, Hon. Chas. R. Thomas and Hon. H. L. Godwin, their interest in the question of drainage and the studies they have made of the subject have contributed so largely to making this convention a success,

Resolved, That the unanimous thanks of the convention be extended to

them as a due expression of our appreciation of their untiring labors in this important cause.

VI. **WHEREAS**, It is manifest that the reclamation of our swamp lands for agriculture and the more effective drainage of our improved swamp lands will greatly enlarge the agricultural possibilities of the State and tend to increase many fold the products of the farm; and

WHEREAS, There are only a limited number of people who are familiar with the modern methods of drainage and reclamation and with the elements of fertility, and the proper cultivation of the black, alluvial lands of eastern North Carolina; now, therefore, be it

Resolved, That the North Carolina Department of Agriculture, either alone or in co-operation with the U. S. Department of Agriculture, be earnestly requested to establish a demonstration farm at some point on the black or swamp lands of eastern North Carolina during the year 1909 for the purpose of experimenting and demonstrating the best methods of drainage, preparing the soil, planting, cultivating and harvesting the staple crops of that section:

Resolved further, That the Trustees of the Agricultural and Mechanical College at Raleigh be requested to give competent instruction in the nature of the swamp alluvial lands in eastern North Carolina, both improved and unimproved, the proper methods of reclamation and drainage, and the constituents and nature of the soil, and the most appropriate crops to be grown thereon, and best methods of cultivating and utilizing the said lands:

Resolved further, That the next session of the General Assembly be requested to authorize the Geological and Economic Survey of the State to employ at least one competent and efficient drainage engineer in order to more effectively prosecute drainage investigations, and to make surveys and plans for drainage districts wherever the same may be necessary or authorized by law, and that a sufficient appropriation be made to defray the necessary expenses thereof.

The report of the Committee on Legislation was then read by the Chairman, Hon. John H. Small, who explained that the recommended legislation was modeled after the plan suggested by Mr. J. O. Wright in his address. The convention voted unanimously to adopt the report of this committee and to refer it to a committee of two, who should carefully revise it and prepare it for transmittal to the Legislature. The committee elected by the convention to do this work was composed of Hon. John H. Small, of Washington, N. C. and Hon. A. D. Ward, of Newbern, N. C.

REPORT OF COMMITTEE ON LEGISLATION.

There is given below the legislation recommended by the convention.

LEGISLATION RECOMMENDED TO MAKE PRACTICABLE THE DRAINAGE OF SWAMP LANDS IN NORTH CAROLINA.

TITLE.

An act to promote the public health, convenience and welfare by leveeing, ditching and draining the wet, swamp and overflowed lands of the State, and providing for the establishment of levee or drainage districts for the purpose of enlarging or changing any natural water courses and for digging ditches or canals for securing better drainage or providing better outlets for drainage, for building levees or embankments and installing tide gates or pumping plants for the reclamation of overflowed lands, and prescribing a method for so doing; and providing for the assessment and collection of the cost and expense of the same, and issuing and selling bonds therefor; and for the care and maintenance of such improvements when constructed.

SECTION 1. DUTY AND POWERS OF THE COURT.—The Clerk of the Superior Court of any county in the State of North Carolina shall have jurisdiction, power and authority to establish a levee or drainage district or districts in his county, and to locate and establish levees, drains or canals, and cause to be constructed, straightened, widened or deepened any ditch, drain or water course, and to build levees or embankments and erect tide gates and pumping plants for the purpose of draining and reclaiming wet, swamp or overflowed lands; and it is hereby declared that the drainage of swamps and the drainage of the surface water from agricultural lands and the reclamation of tidal marshes shall be considered a public benefit and conducive to the public health, convenience, utility and welfare.

SEC. 2. PETITION—BOND—BOARD OF VIEWERS.—Whenever a petition, signed by a majority of the resident landowners in a proposed drainage district, or by the owners of three-fifths of all the land which will be affected by or assessed for the expense of the proposed improvements, shall be filed in the office of the Clerk of the Superior Court of any county in which a part of said lands are located, setting forth that any specific body or district of land in the county and adjoining counties, described in such a way as to convey an intelligent idea as to the location of such land, is subject to overflow or too wet for cultivation, and the public benefit or utility or the public health, convenience or welfare will be promoted by draining, ditching or leveeing the same, or by changing

or improving the natural water courses; and setting forth therein as far as practicable the starting point, route and terminus and lateral branches, if necessary, of the proposed improvement; and there is filed therewith a bond for the amount of \$50 per mile for each mile of the ditch or proposed improvement, signed by two or more sureties or by some lawful and authorized surety company, to be approved by the Clerk of the Superior Court and conditioned for payment of all costs and expenses incurred in the proceedings, in case the court does not grant the prayer of said petition, the said clerk shall issue a summons, to be served on all the defendant landowners who have not joined in the petition and whose lands are included in the proposed drainage district. Upon the return day the said clerk shall appoint a disinterested and competent civil and drainage engineer and two resident freeholders of the county or counties in which said lands are located as a board of viewers to examine the lands described in the petition and make a preliminary report thereon. Such drainage engineer shall be appointed upon the recommendation of the State Geologist, and the compensation for the services of such engineer and his necessary assistants, to be fixed as herein provided, shall be paid preliminarily by the State Geological and Economic Survey, said sum or sums so paid to be refunded when the drainage fund is subsequently provided by the sale of bonds or otherwise.

When the lands proposed to be drained and created into a drainage district are located in two or more counties the Clerk of the Superior Court of either county shall have and exercise the jurisdiction herein conferred, and the venue shall be in that county in which the petition is first filed.

The law and rules regulating special proceedings shall be applicable to this act, so far as may be practicable. The summons may be served by publication as to any defendants who cannot be personally served as provided by law.

SEC. 3: EXAMINATION—PRELIMINARY REPORT.—The Board of Viewers shall proceed to examine the land described in said petition, and other land if necessary to locate properly such improvement or improvements as are petitioned for, along the route described in petition or any other route answering the same purpose, if found more practicable or feasible, and may run levels such as may be necessary to determine the elevation of the several parts of the district, and shall make and return to the Clerk of the Superior Court, within thirty days, unless the time shall be extended by the court, a written report, which shall set forth:

1. Whether the proposed drainage is practicable or not;

2. Whether it will benefit the public health or any public highway or be conducive to the general welfare of the community;

3. Whether the improvement proposed will benefit the lands sought to be benefited;

4. Whether or not all the lands that are benefited are included in the proposed drainage district.

They shall also file with this report a map of the proposed drainage district, showing the location of the ditch or ditches or other improvement to be constructed and the lands that will be affected thereby, and such other information as they may have collected that will tend to show the correctness of their findings.

SEC. 4. FILING PRELIMINARY REPORT.—The Clerk of the Superior Court shall consider this report. If the viewers report that the drainage is not practicable or that it will not benefit the public health or any public highway or be conducive to the general welfare of the community, and the court shall approve such finding, the petition shall be dismissed at the cost of the petitioners. Such petition or proceeding may again be instituted by the same or additional landowners at any time after six months, upon proper allegations that conditions have changed or that material facts were omitted or overlooked.

If the viewers report that the drainage is practicable and that it will benefit the public health or any public highway, or be conducive to the general welfare of the community, and the court shall so find, then the court shall fix a day when the report will be further heard and considered.

SEC. 5. NOTICE.—If the petition is entertained by the court, notice shall be given by publication for two consecutive weeks in some newspaper of general circulation within the county or counties, if one shall be published in such counties, and also by posting a written or printed notice at the door of the courthouse and at five conspicuous places within the drainage district, that on the date set, naming the day, the court will consider and pass upon the report of the viewers. At least fifteen days shall intervene between the date of the publication and the posting of the notices and the date set for the hearing.

SEC. 6. HEARING PRELIMINARY REPORT.—At the date appointed for the hearing the court shall hear and determine any objections that may be offered to the report of the viewers. If it appear that there is any land within the proposed levee or drainage district that will not be affected by the leveeing or drainage thereof, such lands shall be excluded and the names of the owners withdrawn from such proceeding; and if it shall be shown that there is any land not within the proposed district that will be affected by the construction of the proposed levee or drain, the

boundary of the district shall be so changed as to include such land, and such additional landowners shall be made parties plaintiff or defendant, respectively, and summons shall issue accordingly, as hereinbefore provided. After such change in the boundary is made, the sufficiency of the petition shall be verified, to determine whether or not it conforms to the requirements of the statute, as provided in section 2. The efficiency of the drainage or levees may also be determined, and if it appears that the location of any levee or drain can be changed so as to make it more effective, or that other branches or spurs should be constructed, or that any branch or spur projected may be eliminated, or other changes made that will tend to increase the benefits of the proposed work, such modification and changes shall be made by the court. The engineer and the other two viewers may attend this meeting and give any information or evidence that may be sought to verify and substantiate their report. If necessary, the petition, as amended, shall be referred by the court to the engineer and two viewers for further report.

The above facts having been determined to the satisfaction of the court, and the boundaries of the proposed district so determined, it shall declare the establishment of the drainage or levee district, which shall be designated by a name or number, for the object and purpose as herein set forth.

SEC. 7. MAY CONDEMN LAND.—If it shall be necessary to acquire a right of way or an outlet over and through lands not affected by the drainage, and the same cannot be acquired by purchase, then and in such event the power of eminent domain is hereby conferred, and the same may be condemned. Such owner or owners of the land proposed to be condemned may be made parties defendant, and the procedure shall be substantially as provided for the condemnation of rights of way for railroads in chapter 61 of the Revisal of 1905, so far as the same may be applicable.

SEC. 8. RIGHT OF APPEAL.—Any person or corporation owning lands within the drainage or levee district which he or it thinks will not be benefited by the improvement and should not be included in the district may appeal from the decision of the court to the Superior Court of such county, in term time, by filing an appeal, accompanied by a bond conditioned for the payment of the costs, if the appeal should be decided against him, for such sum as the court may require, not exceeding \$200, signed by two or more solvent sureties or by some approved surety company, to be approved by the court.

SEC. 9. COMPLETE SURVEY.—After the district is established, the court shall refer the report of the engineer and viewers back to them to

make a complete survey, plans and specifications for the drainage or levees, and fix a time when said engineer and viewers shall complete and file their report, not exceeding sixty days.

SEC. 10. COMPLETE REPORT.—The engineer and viewers shall have power to employ such assistants as may be necessary to make a complete survey of the drainage district, and shall enter upon the ground and make a survey of the main drain, or drains, and all its laterals. The line of each ditch, drain or levee shall be plainly and substantially marked on the ground. The course and distance of each ditch shall be carefully noted and sufficient notes made, so that it may be accurately platted and mapped. A line of levels shall be run for the entire work, and sufficient data secured, from which accurate profiles and plans may be made. Frequent bench-marks shall be established along the line on permanent objects and their elevation recorded in the field books. If it is deemed expedient by the engineer and viewers, other levels may be run to determine the fall from one part of the district to another. If an old water course, ditch or channel is being widened, deepened or straightened, it shall be accurately cross-sectioned, so as to compute the amount of cubic yards saved by the use of such old channel. A drainage map of the district shall then be completed, showing the location of the ditch or ditches and other improvements, and the boundary, as closely as may be determined by the records of the lands owned by each individual land-owner within the district. The location of any railroads or public highways and the boundary of any incorporated towns or villages within the district shall be shown on the map. There shall also be prepared to accompany this map a profile of each levee, drain or water course, showing the surface of the ground, the bottom or grade of the proposed improvement and the number of cubic yards of excavation or fill in each mile or fraction thereof, and the total yards in the proposed improvement and the estimated cost thereof, and the cost of any other work required to be done.

SEC. 11. ASSESSMENT OF DAMAGES.—It shall be the further duty of the engineer and viewers to assess the damages claimed by any one that are justly right and due to them for land taken or for inconvenience imposed because of the construction of the improvement or for any other legal damages sustained. Such damage shall be considered separate and apart from any benefit the land would receive because of the proposed work.

SEC. 12. CLASSIFICATION OF LAND ACCORDING TO BENEFITS.—It shall be the further duty of the engineer and viewers to personally examine the land in the district and classify it with reference to the

benefit it will receive from the construction of the levee, ditch, drain or water course or other improvement. In the case of drainage the degree of wetness of the land, its proximity to the ditch or a natural outlet and the fertility of the soil shall be considered in determining the amount of benefit it will receive by the construction of the ditch. The land benefited shall be separated into five classes. The land receiving the highest benefit shall be marked "Class A"; that receiving the next highest benefit, "Class B"; that receiving the next highest benefit, "Class C"; that receiving the next highest benefit, "Class D," and that receiving the smallest benefit, "Class E." The holdings of any one landowner need not necessarily be all in one class, but the number of acres in each class shall be ascertained, though its boundary need not be marked on the ground or shown on the map. The total number of acres owned by one person in each class and the total number of acres benefited shall be determined. The total number of acres of each class in the entire district shall be obtained and presented in tabulated form. The scale of assessment upon the several classes of land returned by the engineer and viewers shall be in the ratio of 1, 2, 3, 4 and 5—that is to say, as often as five mills per acre is assessed against the land in Class A four mills per acre shall be assessed against the land in Class B, three mills per acre in Class C, two mills per acre in Class D, and one mill per acre in Class E. This shall form the basis of the assessment of benefits to the lands for drainage purposes.

SEC. 13. COST OF THE SURVEY.—The engineer and viewers shall keep an accurate account and report to the court the name and number of days each person was employed on the survey and the kind of work he was doing, and any expenses that may have been incurred in going to and from the work, and the cost of any supplies or material that may have been used in making the survey.

SEC. 14. DELAY—EXTENSION OF TIME.—In case the work is delayed by high water, sickness or any other good cause, and the report is not completed at the time fixed by the court, the engineer and viewers shall appear before the court and state in writing the cause of such failure, and ask for sufficient time in which to complete the work, and the court shall set another date, by which the report shall be completed and filed.

SEC. 15. FINAL REPORT—NOTICE OF HEARING.—When the final report is completed and filed, it shall be examined by the court, and if it is found to be in due form and in accordance with the law, it shall be accepted, and if not in due form, it may be referred back to the engineer and viewers, with instruction to secure further information, to be reported at a subsequent date, to be fixed by the court. When the report is fully

completed and accepted by the court, a date shall be fixed by the court for the final hearing upon the report, not less than twenty days, and notice thereof given by publication in a newspaper of general circulation in the county and by posting a written or printed notice on the door of the courthouse and at five conspicuous places throughout the district, such publication to be made for at least two weeks before the final hearing. During this time a copy of the report shall be on file in the office of the Clerk of the Superior Court and shall be open to the inspection of any landowner or other person interested within the district.

SEC. 16. ADJUDICATION—FINAL REPORT.—At the date set for hearing, any landowner may appear in person or by counsel and file his objection in writing to the report of the viewers; and it shall be the duty of the court to carefully review the report of the viewers and the objections filed thereto, and make such changes as are necessary to render substantial and equal justice to all the landowners in the district. If, in the opinion of the court, the cost of construction, together with the amount of damages assessed, is not greater than the benefits that will accrue to the land affected, the court shall confirm the report of the viewers. If, however, the court finds that the cost of construction, together with the damages assessed, is greater than the resulting benefit that will accrue to the lands affected, the court shall dismiss the proceedings at the cost of the petitioners, and the sureties upon the bond so filed by them shall be liable for such costs: *Provided*, that the State Geological and Economic Survey may remit and release to the petitioners the costs expended by said board on account of the engineer and his assistants. The court may from time to time collect from the petitioners such amounts as may be necessary to pay costs accruing, other than costs of the engineer and his assistants, such amounts to be repaid from the special tax hereby authorized.

SEC. 17. APPEAL.—Any party aggrieved may, within ten days after the confirmation of the assessor's report, appeal to the Superior Court in term time. Such appeal shall be taken and prosecuted as now provided in appeals in special proceedings.

SEC. 18. DRAINAGE RECORD.—The Clerk of the Superior Court shall provide a suitable book, to be known as the Drainage Record, in which he shall transcribe every petition, motion, order, report, judgment or finding of the court in every drainage transaction that may come before it, in such a manner as to make a complete and continuous record of the case. Copies of all the maps and profiles are to be furnished by the engineer and marked by the clerk "Official Copies," which shall be kept on file by him in his office, and one other copy shall be pasted or otherwise attached to his record book.

SEC. 19. After the said drainage district shall have been declared established, as aforesaid, and the survey and plans therefor approved, the court shall appoint three persons, who shall be disinterested, as "The Board of Drainage Commissioners." Such drainage commissioners shall first be elected by the owners of land within the drainage or levee district, or by a majority of same, in such manner as the court shall prescribe. The court shall appoint those receiving a majority of the votes. If any one or more of such proposed commissioners shall not receive the vote of a majority of such landowners, the court shall appoint all or the remainder from among those voted for in the election. Any vacancy thereafter occurring shall be filled in like manner. Such three drainage commissioners, when so appointed, shall be immediately created a body corporate, under the name and style of "The Board of Drainage Commissioners of ——— District," with the right to hold property and convey the same, to sue and be sued, and shall possess such other powers as usually pertain to corporations. They shall organize by electing from among their number a chairman and a vice-chairman. They shall also elect a secretary, either within or without their body. The treasurer of the county in which the proceeding was instituted shall be *ex officio* treasurer of such drainage commissioners. Such Board of Drainage Commissioners shall adopt a seal, which they may alter at pleasure.

The Board of Drainage Commissioners shall have and possess such powers as are herein granted. The name of such drainage district, whether designated by number or otherwise, shall constitute a part of its corporate name; for illustration, "The Board of Drainage Commissioners of (No. 1, or Moyock) District."

SEC. 20. SUPERINTENDENT OF CONSTRUCTION.—The Board of Drainage Commissioners shall appoint a competent person as superintendent of construction. Such person shall furnish a bond, to be approved by the commissioners, in the penal sum of \$10,000, conditioned upon the honest and faithful performance of his duties, such bond to be in favor of the Board of Drainage Commissioners.

SEC. 21. NOTICE OF LETTING CONTRACT—BOND.—The Board of Drainage Commissioners shall cause notice to be given for two consecutive weeks in some newspaper published in the county wherein such improvement is located, if such there be, and such additional publication elsewhere as they may deem expedient, of the time and place of letting the work of construction of said improvement, and in such notice they shall specify the approximate amount of work to be done and the time fixed for the completion thereof; and on the date appointed for the letting, they, together with the superintendent of construction, shall

convene and let to the lowest responsible bidder, either as a whole or in sections, as they may deem most advantageous for the district, the proposed work. No bid shall be entertained that exceeds the estimated cost, except for good and satisfactory reasons it shall be shown that the original estimate was erroneous. They shall have the right to reject all bids and advertise again the work, if in their judgment the interests of the district will be subserved by doing so. The successful bidder shall be required to enter into a contract with the Board of Drainage Commissioners and to execute a bond for the faithful performance of such contract, with sufficient sureties, in favor of the Board of Drainage Commissioners, for the use and benefit of the levee or drainage district, in an amount equal to 25 *per centum* of the estimated cost of the work awarded to him.

SEC. 22. The superintendent in charge of construction shall make monthly estimates of the amount of work done and furnish one copy to the contractor and file the other with the secretary of the Board of Drainage Commissioners; and the commissioners shall, within five days after the filing of such estimate, meet and direct the secretary to draw a warrant in favor of such contractor for 90 *per centum* of the work done, according to the specifications and contract; and upon the presentation of such warrant, properly signed by the chairman and secretary, to the treasurer of the drainage fund, he shall pay the amount due thereon. When the work is fully completed and accepted by the superintendent, he shall make an estimate for the whole amount due, including the amounts withheld on the previous monthly estimates, which shall be paid from the drainage fund, as before provided.

SEC. 23. FAILURE OF CONTRACTOR—RELETTING.—If any contractor to whom a portion of said work shall have been let shall fail to perform the same according to the terms specified in his contract, action may be had in behalf of the Board of Drainage Commissioners against such contractor and his bond in the Superior Court for damages sustained by the levee or drainage district, and recovery made against such contractor and his sureties. In such an event the work shall be advertised and relet in the same manner as the original letting.

SEC. 24. RIGHT OF CONTRACTOR.—In the construction of the work the contractor shall have the right to enter upon the lands necessary for this purpose, and the right to remove private or public bridges or fences, and to cross private lands in going to or from the work. In case the right of way of the improvement is through timber, the owner thereof shall have the right to remove it, if he so desires, before the work of construction begins, and in case it is not removed by the landowner it shall become the property of the contractor and may be removed by him.

SEC. 25. HIGHWAYS AFFECTED.—Where any public ditch, drain or water course established under the provisions of this act crosses a public highway, the actual cost of constructing the same across the highway or removing old bridges or building new ones shall be paid for from the fund of the drainage district. Wherever any highway within the levee or drainage district shall be beneficially affected by the construction of any improvement or improvements in such district, it shall be the duty of the viewers appointed to classify the land, to give in their report the amount of benefit to such highway, and notice shall be given by the Clerk of the Superior Court to the clerk of the Board of County Commissioners in the county where the road is located of the amount of such assessment, and the county commissioners shall have the right to appear before the court and file its objections, the same as any landowner.

SEC. 26. RAILROAD—DAMAGE—BENEFIT.—Whenever the engineer and the viewers in charge shall make a survey for the purpose of locating a public levee or drainage district or changing a natural water course, and the same would cross the right of way of any railroad company, it shall be the duty of the viewers in charge of the work to notify the railroad company by serving written notice upon the agent of such company or its lessee or receiver that they will meet the company at the place where the proposed ditch, drain or water course crosses the right of way of such company, said notice fixing the time of such meeting shall not be less than ten days after the service of the same, for the purpose of conferring with said railroad company with relation to the place where and the manner in which such improvement shall cross such right of way. When the time shall arrive fixed for such conference, unless for good cause more time is agreed upon, it shall be the duty of the viewers in charge and the railroad company to agree, if possible, upon the place where and the manner and method in which such improvement shall cross such right of way. If the viewers in charge and the railroad company cannot agree, or if the railroad company shall fail, neglect or refuse to confer with the viewers, they shall determine the place and manner of crossing the right of way of said railroad company, and shall specify the number and size of openings required, and the damages, if any, to said railroad company, and so specify in their report. The fact that the railroad company is required by the construction of the improvement to build a new bridge or culvert, or to enlarge or strengthen an old one, shall not be considered as damages to said railroad company. The engineer and viewers shall also assess the benefits that will accrue to the right of way, roadbed and other property of said company by affording better drainage or a better outlet for drainage, but no benefits shall be assessed

because of the increase in business that may come to said road because of the construction of the improvement. The benefits shall be assessed as a fixed sum, determined solely by the physical benefit that its property will receive by the construction of said improvement, and it shall be reported by the viewers as a special assessment, due personally from the railroad company; and unless the same is paid when due by the company as a special assessment, it may be collected in the manner of an ordinary debt in any court having jurisdiction.

SEC. 27. NOTICE TO RAILROAD.—The Clerk of the Superior Court shall have notice served upon the railroad company of the time and place of the meeting to hear and determine the final report of the engineer and viewers, and the said railroad company shall have the right to file objections to said report and to appeal from the findings of the board of commissioners in the same manner as any landowner, but such an appeal shall not delay or defeat the construction of the improvement.

SEC. 28. MANNER OF CROSSING RIGHT OF WAY—PENALTY FOR DELAY—COST.—After the contract is let and the actual construction is commenced, if the work is being done with a floating dredge, the superintendent in charge of construction shall notify the railroad company of the probable time at which the contractor will be ready to enter upon the right of way of said road and construct the work thereon. It shall be the duty of said railroad to send a representative to view the ground with the superintendent of construction, and arrange the exact time at which such work can be most conveniently done. At the time agreed upon, the said railroad company shall remove its rails, ties, stringers and such other obstructions as may be necessary to permit the dredge to excavate the channel across its right of way. The work shall be so planned and conducted as to interfere in the least possible manner with the business of said railroad.

In case the railroad company refuses and fails to remove its track and allow the dredge to construct the work on its right of way, it shall be held as delaying the construction of the improvement, and such company shall be liable to a penalty of \$25 per day for each day of delay, to be collected by the Board of Drainage Commissioners for the benefit of the drainage district, as in the case of other penalties. Such a fine may be collected in any court having jurisdiction, and shall inure to the benefit of the drainage district. Within thirty days after the work is completed, an itemized bill for the actual expenses incurred by the railroad company for opening its tracks shall be made and presented to the superintendent of construction of the drainage improvement. Such bill, however, shall

not include the cost of putting in a new bridge or strengthening or enlarging an old one. The superintendent of construction shall audit this bill and, if found correct, approve the same and file it with the secretary of the Board of Drainage Commissioners. The commissioners shall deduct from this bill the cost of the excavation done by the dredge on the right of way of said railroad company at the contract price, and pay the difference, if any, to said railroad company.

SEC. 29. CONTROL AND REPAIRS.—Whenever any improvement constructed under this act is completed, it shall be under the control and supervision of the Board of Drainage Commissioners. It shall be the duty of the said board to keep the levee, ditch, drain or water course in good repair, and for this purpose they may levy an assessment on the lands benefited by the construction of such improvement in the same manner and in the same proportion as the original assessments were made, and the fund that is collected shall be used for repairing and maintaining the ditch, drain or water course in perfect order: *Provided, however,* that if any repairs are made necessary by the act or negligence of the owner of any land through which such improvement is constructed, or by the act or negligence of his agent or employee, or if the same is caused by the cattle, hogs or other stock of said owner, employee or agent, then the cost thereof shall be assessed and levied against the lands of said owner alone, to be collected by proper suit instituted by the drainage commissioners.

It shall be unlawful for any person to injure or damage or obstruct or build any bridge, roadway, fence or floodgate in such a way as to injure or damage any levee, ditch, drain or water course constructed or improved under the provisions of this act, and any person causing such injury shall be guilty of a misdemeanor, and upon conviction thereof may be fined in any sum not exceeding twice the damage or injury done or caused.

SEC. 30. OUTLET FOR LATERAL DRAINS.—The owner of any land that has been assessed for the cost of the construction of any ditch, drain or water course as herein provided shall have the right to use the ditch, drain or water course as an outlet for lateral drains from said land; and if said land is separated from the ditch, drain or water course by the land of another or others, and the owner thereof shall be unable to agree with said other or others as to the terms and conditions on which he may enter their lands and construct said drain or ditch, he may file his ancillary petition in such pending proceeding to the court, and the procedure shall be as now provided by law. When the ditch is constructed it shall become a part of the drainage system and shall be under the control of

the Board of Drainage Commissioners and kept in repair by them as herein provided.

SEC. 31. ASSESSMENT TAX ROLL.—After the classification of the land and the ratio of assessment of the different classes to be made thereon has been confirmed by the court, the drainage commissioners shall prepare an assessment roll or drainage tax duplicate, giving a description of all the land in said drainage district, the name of the owner, so far as can be ascertained from the public records, and the amount of assessment against each of the several tracts of land.

In preparing this assessment roll the board shall ascertain the total cost of the improvement, including the damages awarded and paid to the owners of land, and all incidental expenses, and deduct therefrom any special assessment made against any railroad or highway, and the remainder shall be the amount to be borne and paid by the lands benefited. This amount shall be assessed against the said tracts of land according to the benefit received, as shown by the classification and ratio of assessment made by the viewers and confirmed by the Board of County Commissioners.

This drainage tax roll shall be made in duplicate, signed by the chairman and secretary, and one copy filed with the drainage record and the other delivered to the sheriff or other county tax collector. There shall be appended an order to collect the said assessments, and the same shall have the force and effect of a judgment, as in the case of State and county taxes.

SEC. 32. TIME OF PAYMENT.—If the total cost of the work is less than an average of 25 cents per acre on all the land in the district, the assessment made against the several tracts shall be collected in one installment by the same officer and in the same manner as State and county taxes are collected, and payable at the same time. In case the total assessment exceeds the average of 25 cents per acre on all the lands in the district, the said Board of Drainage Commissioners may give notice of three weeks, by publication in some newspaper of general circulation in the district, that they propose to issue bonds for the construction of said improvement, giving the amount of bonds to be issued, the rate of interest they are to bear and the time when payable. Any landowner having lands assessed in the district and not wanting to pay interest on the bonds may, within thirty days after the publication of said notice, pay the County Treasurer the full amount of his assessment and have his land released therefrom.

SEC. 33. DEFENSE—WAIVER.—Each and every person owning land in the district which is assessed for the construction of an improvement, who

shall neglect or fail to pay the full amount of his assessment to the County Treasurer within the time specified, shall be deemed as consenting to the issuing of said drainage bonds, and in consideration of the right to pay his assessment in installments he hereby waives his right to any defense against the collection of said assessment because of any irregularity, illegality or defect in the proceedings prior to this time, except in the case of an appeal, as heretofore provided, which is not affected by this waiver. The term "person," as used in this act, includes any firm, company or corporation.

SEC. 34. BOND ISSUE.—At the expiration of the thirty days after the publication the Board of Drainage Commissioners may issue bonds for the full amount of the assessment not paid in to the County Treasurer, together with the interest thereon, costs of collection or other incidental expenses. These bonds shall bear 6 per cent. interest per annum, payable annually, and shall be paid in ten equal annual installments. The first installment of the principal shall mature at the expiration of three years from the date of issue, and one installment each succeeding year for nine additional years. The commissioners may sell these bonds at not less than par and devote the proceeds to the payment of the work as it progresses. In no case shall bonds be issued until the tax levy has been made to meet them as they come due. The bonds issued shall be for the exclusive use of the levee or drainage district specified on their face, and should be numbered by the Board of Drainage Commissioners and recorded in the drainage record, which record shall set out specifically the lands embraced in the district on which the tax has not been paid in full, and which land is assessed for the payment of the bonds issued and the interest thereon.

This assessment shall constitute the first and paramount lien, second only to State and county taxes, upon the lands assessed for the payment of said bonds and the interest thereon as they become due, and shall be collected in the same manner by the same officers as the State and county taxes are collected. The official bonds of the tax collector and County Treasurer shall be liable for the faithful performance of the duties herein assigned them. Such bonds may be increased by the Board of County Commissioners.

SEC. 35. RE-LEVY.—Where the court has confirmed an assessment for the construction of any public levee, ditch or drain, and such assessment has been modified by the court of superior jurisdiction, but for some unforeseen cause it cannot be collected, the Board of Drainage Commissioners shall have power to change or modify the assessment as originally

confirmed to conform to the judgment of the Superior Court; and to cover any deficit that may have been caused by the order of said court or unforeseen occurrence, the said re-levy shall be made for the additional sum required in the same ratio on the lands benefited as the original assessment was made.

SEC. 36. FEES AND EXPENSES.—Any engineer employed under the provisions of this act shall receive such compensation per diem for his services as shall be fixed and determined by the court. The viewers, other than the engineer, shall receive \$3 per day; the rodmen, axemen, chainmen and other laborers shall receive \$2 per day each. All other fees and costs incurred under the provisions of this act shall be the same as provided by law for like services in other cases. Said costs and expenses shall be paid by the order of the court out of the drainage fund provided for that purpose, and the Board of Drainage Commissioners shall issue warrants therefor when funds shall be in the hands of the treasurer.

SEC. 37. DEFECTS IN PROCEEDINGS.—The provisions of this act shall be liberally construed to promote the leveeing, ditching, draining and reclamation of wet and overflowed lands. The collection of the assessment shall not be defeated, where the proper notices have been given, by reason of any defect in the proceedings occurring prior to the order of the court confirming the final report of the viewers; but such order or orders shall be conclusive and final that all prior proceedings were regular and according to law, unless they were appealed from. If, on appeal, the court shall deem it just and proper to release any person or to modify his assessment or liability, it shall in no manner affect the rights and legality of any person other than the appellant, and the failure to appeal from the order of the court within the time specified shall be a waiver of any illegality in the proceedings, and the remedies provided for in this act shall exclude all other remedies.

SEC. 38. Proceedings under this act may be *ex parte* or adversary. Any engineer, viewer, superintendent of construction or other person appointed under this act may be removed by the court, upon petition, for corruption, negligence of duties or other good and satisfactory cause shown.

SEC. 39. All laws in conflict with this act are hereby repealed.

SEC. 40. This act shall be in effect from and after its ratification.

As explanatory to certain sections of this recommended legislation, the following paper that has been prepared by Mr. J. O. Wright, is attached to the record of the convention.

THE ASSESSMENT OF BENEFITS AND DAMAGES IN A PUBLIC DRAINAGE DISTRICT.

BY J. O. WRIGHT.

By the drainage of wet lands, there are two classes of benefits created: (1) The benefit that accrues to the land itself by making it more productive and thereby increasing its commercial value; and (2) a benefit that comes to the community at large by improving the public health, convenience and welfare. The first of these is a private matter and the second a public utility. It is because of this latter function that drainage laws are enacted. The Supreme Court of Indiana in *Tillman vs. Kircher*, 64, Indiana, page 104, has held that "the legislature cannot constitutionally enact any law authorizing one person to improve the lands of another by means of drainage and compel the person benefited to pay to the other an assessment therefor, unless the public health is also in some way benefited thereby, as that the drainage is necessary and is conducive to the public health, convenience, or welfare, or a public benefit or utility, and then it can be done only by due course of law." If, therefore, it is proposed to establish a drain that is of great benefit to one or more landowners and there is nothing pertaining to public health, use, convenience, or welfare, such a drain could not be constructed across the lands of another, even by paying for the privilege, without his consent, and any law purporting to give such right would be unconstitutional, null and void. So, the fundamental idea then on which all drainage laws are based is that drainage is a public function and not a private enterprise.

Again, drainage is of such a character that it cannot be carried to any great extent without some form of co-operation. Frequently the wet area is large and one landowner cannot drain his land without affecting those of another. The question whether or not one or more landowners can compel an individual against his will to bear a portion of the expense of a drain for the common good reaches to the foundation of our civil government. By what authority can one man or any number of men say to another that "we propose to drain a certain area of land, a part of which you own and you shall pay your share of the expense?" The only ground for such authority must be his consent, either expressed or implied. When one becomes a citizen of the State, either by birth or adoption, there are certain things he tacitly agrees to do or consents to having done, such as sharing in the administrative expense of the government to construct and maintain certain highways, to build and support public schools, to establish and maintain benevolent and penal institutions, and to do and suffer many things for the common good. These and many other burdens

to be borne by the citizens of the State should be equal and uniform. A citizen may remain on his own premises and not use a public highway, yet he must pay a road tax. He may have no children to educate, yet he must pay a school tax. He may have no need for the insane asylum, still he is taxed to support it. In such matters, man is viewed as a part of the community and a citizen of the State and not as an individual. He still possesses certain rights, but they are held subservient to the common good.

Our governments, both State and National, have recognized that drainage is for the common good and every individual landowner must contribute his just proportion to its construction. In order to secure this end, practically all the States have passed some form of a drainage law based on the above fundamental principles. These laws very justly recognize that the individuals have certain rights that must be respected, as well as certain obligations that must be enforced. The first of these rights is that private property may not be taken for public use without due process of law and after just compensation has been paid or secured. Under this constitutional provision, commonly called the right of eminent domain, the land may be condemned for a public highway or for a public drain. Although the improvement may not be used by the community at large, if it serves all the people of that particular locality, be they few or many, it is held to be of public use and is not opposed to the constitution.

DAMAGES.

The damages that may result from the establishment and construction of a public drain are:

1. For the land actually appropriated and used for the construction of an open ditch or drain. If the improvement consists of widening and deepening a channel that already exists, the courts in some States have held that no damage should be allowed. That being the natural course of the water, the owner of the land is bound to furnish such additional right of way as might become necessary by development and improvement of the natural watershed. If, however, the improvement involves the cutting off of bends and the digging of new channels where none exists, or the cutting through of ridges and diverting the water that formerly flowed in some other course, then a fair market value must be paid to the owner for the land so appropriated for use for the common good.

2. If, by the construction of an open ditch or drain, the arable land is cut up so as to increase the cost of cultivation and harvesting of the crops, or a bridge is required so as to get from one part of the field to another, then these facts should be taken into consideration and a reason-

able damage allowed for such additional expense as the owner will be compelled to incur, but nothing should be allowed for fanciful inconvenience.

3. When an open ditch passes through a forest, it is desirable to have the timber removed for a short distance on each side to prevent the leaves and twigs from falling in and obstructing the ditch. In such case the owner should be permitted to remove the timber at his own expense for his own benefit, or it should be appraised standing and paid for and removed by the drainage district. In all such cases the actual cash value of the property taken or destroyed should be determined by competent viewers after an inspection of the premises and a fair and reasonable value allowed for the same.

DAMAGES TO RAILROADS AND HIGHWAYS.

If, in the construction of a drainage system, any railroad or public highway should be damaged, it should be compensated for such damages. But the instances are very rare in which such damage will occur. It was formerly held that if in the construction of a ditch crossing a railroad or highway it became necessary to enlarge the waterway or build a new bridge that such expense was a damage, but a recent ruling of the Supreme Court has changed this doctrine. The Supreme Court of the United States, affirming the decision in the case of the C. B. & Q. Railroad Company *vs.* the Commissioner of Drainage District No. 1, Bristol Township, Kendall County, Ill., 212 Ill., p. 103, sets forth the law governing cases of this kind as follows:

When the railroad company laid the foundations of its bridge in Rob Roy Creek it did so subject to the rights of the public in the use of that water-course, and also subject to the possibility that new circumstances and future public necessities might, in the judgment of the State, reasonably require a material change in the methods used in crossing the creek with cars. It may be—and we take it to be true—that the opening under the bridge as originally constructed was sufficient to pass all the water then or now flowing through the creek. But the duty of the company, implied in law, was to maintain an opening under the bridge that would be adequate and effectual for such an increase in the volume of water as might result from lawful, reasonable regulations established by appropriate public authority from time to time for the drainage of lands on either side of the creek. . . . The great weight of authority is that where there is a natural waterway, or where a highway already exists and is crossed by a railroad company under its general license to build a railroad, and without any specific grant by the legislative authority to obstruct the highway or waterway, the railway company is bound to make and keep its crossing, at its own expense, in such condition as shall meet all the reasonable requirements of the public as the changed conditions and increased use may demand. . . . The duty of a railroad to restore a stream or highway which is crossed by the line of its road is a continuing duty; and if,

by the increase of population or other causes, the crossing becomes inadequate to meet the new and altered conditions of the country, it is the duty of the railroads to make such alterations as will meet the present needs of the public. . . . The duty of the new company will end when it removes the obstructions which it has placed in the way of enlarging, deepening, and widening the channel. It follows, upon principles of justice, that while the expense attendant upon the removal of the present bridge and culvert and the timbers and stones placed by the company in the creek, as well as the expense of the erection of any new bridge which the company may elect to construct in order to conform to the plan of the commissioners, should be borne by the railway company, the expense attendant merely upon the removal of soil in order to enlarge, deepen, and widen the channel must be borne by the district.

If, however, the work is to be done by a dredge boat and a railroad company is required to open its tracks, as it should be to promote the passage of the boat, the necessary expense incurred is a damage to the railroad company and it should be reimbursed for such outlay. The same is true concerning the bridges of a public highway. If it should be necessary to remove them to facilitate the construction of the ditch, the work should be done by the proper authorities and not by the contractor, and just compensation should be made for the same. In some instances a ditch parallels a highway and the excavated material is placed on it to increase the height of the grade or embankment. While this is being done it is often necessary to provide a temporary road to accomodate the travel and such work is an expense or damage to the highway commissioners and they should be allowed a reasonable compensation for such damages. The damages to the landowner and to the railroads and highways should be viewed and considered separate and apart from any benefits that they may receive from the construction of the work. In fact, I think it would be good practice to have the damages estimated and determined by one set of viewers and the benefits by a different set. In this way it would be possible to fairly separate the two so that the assessment of one would not affect the other. When the damages are ascertained they should be added to the cost of excavation, together with the legal and administrative expenses, to form the total cost of the work.

ASSESSMENT OF BENEFITS.

It is a fundamental principle of most drainage laws that a public drain will not be established unless the benefits resulting from its construction exceed the total cost of the work. It is generally conceded that the persons receiving the benefits should pay for the cost of the improvement. This seems to be a just and fair proposition, but the difficulty arises in distributing this cost among the several beneficiaries. From a wide personal

knowledge throughout many States and from published articles on the subject, the writer is convinced that there is no definite method in vogue for apportioning this cost, and the results are not uniform. In presenting a map of the drainage district with a full description as to location and character of the land to different engineers and drainage commissioners requesting them to indicate the relative amount of assessment on certain tracts, the results vary exceedingly. The several amounts seem to be something of a guess and in some instances poor guessing is done. The writer has known viewers to pass over the land and say that this tract should be assessed so many dollars, the next one some given amount, and the third still a different amount, without reference to any fixed system or method of determining the several amounts thus placed on the different tracts. This great diversity in the results obtained is either because a law on the subject is indefinite and uncertain or else its provisions are not well understood. In a few of the States, as Louisiana and Florida, the drainage laws provide for a fixed sum per acre assessed uniformly on all the land in the district. This method is manifestly unjust and it will be but a few years until the laws in these States are modified and the plan placed on a more rational basis. In most of the States, however, the law provides that the assessment shall be in proportion to the benefits received from the construction of the proposed improvement. In the drainage law of Indiana, acts of 1907, page 515, the third cause for remonstrance "By any person or persons whose lands are assessed as benefited, that his or their lands are assessed too much as compared with other lands assessed as benefited or damaged, specifying the same." And, fourth, cause "By any person or persons whose lands are assessed as benefited, that other tracts specifying the same, are assessed too low according to the benefits to be received."

This principle, though differently expressed, is the gist of most of the State laws on the subject of drainage. The Supreme Court of Indiana has repeatedly held that the land must be assessed in proportion to the benefits received. This being the law, the question for us to consider is: How shall we determine the relative amount of benefits the several tracts of land in a drainage district will receive from the proposed improvement?

There are certain inherent attributes in all land which affect its value. Some of these can be modified by the construction of a ditch or drain and some cannot. If the construction of a proposed improvement affects these attributes so as to benefit the land, they should be taken into consideration in the assessment of benefits, but if they are of a nature as not to be affected by the construction of the ditch or drain, then they should have no weight in making the assessment. These attributes are:

1. Absolute location.
2. Relative position.
3. Degree of wetness.
4. Fertility of the soil.
5. Character of the surface.
6. General healthfulness.

The first of these—the *location of the tract*—cannot be affected by the construction of the ditch or drain. If one portion of marsh is near a railroad station or a large city so as to have ready transportation and a good market, and another portion is situated at a remote distance and each were reclaimed by a system of drainage, the former would be of much more value to its owner because of this nearness to market, than the latter, but this increase would be due to its location and not to the effects of drainage. The two tracts, if cultivated in the same crop, might produce the same amount of vegetables or grain. This would show them to be equal in productive power. A crop on the tract nearest the market or railroad might net its owner several times more than the other, but this increased market value would not be due to the effect of drainage but to the location of the land with reference to the market. The location of the land has nothing to do with the quantity of the crop that the land will produce after the improvement is made, but affects solely cost of marketing such a crop. One piece of the land might be better cultivated or planted in a crop having a higher commercial value than another, but this would not be due to the construction of the improvement and should not be taken into account in assessing the benefits.

Relative Position.—By relative position is meant the relation the several tracts of land bear to each other and to the outlet as furnished by the proposed improvement, and not some outlet which already exists. The drainage laws of practically all the States say that the land shall be assessed according to the benefits received by the construction of some specific improvement. It is not, therefore, to be assessed for the benefits received for some improvements which already exist. If a given tract of land is no nearer an adequate outlet when the ditch is completed than before, it should not be assessed for the construction. If, however, the proposed ditch brings an adequate outlet to the land or closer to it than it was before, it should be assessed accordingly. Even if a tract of land lies back several rods from the improvement and has no water removed from it by the construction of the ditch or drain, it is benefited inasmuch as the outlet is brought nearer to it than it was before the ditch was constructed; hence proximity of the land to the ditch is an element to be

considered in assessing the benefits. It must be borne in mind, however, that the law says the assessment shall be according to the benefits received and not according to the cost of securing them. Two pieces of land situated in the same drainage district may by the construction of a drain receive equal benefits, but because it costs more to bring these benefits to one of these tracts than to the other it should not be assessed higher than the other. In many places it is customary for the viewers to place a lower assessment on land near the mouth of the ditch than on similar land receiving the same amount of benefits from the construction of the proposed drain situated nearer the upper end of the ditch. This is contrary to the provision of the statute and is not in accordance with the recognized practice of assessing benefits. It is the relative amount of benefits secured and not the cost of securing them that must be taken into consideration. In an assessment for street improvement in a city, all of the lots fronting on the street are assessed equal amounts per front foot. One end of this street, however, may be level, requiring a large amount of excavation. In such case it costs much more to improve the street in front of a lot on one end of the street than on the other, yet they are taxed the same amount per front foot because they are each supposed to receive the same amount of benefit from the improvement of the street.

Under the drainage laws as now framed this same principle must prevail. Each tract of land must be taxed in proportion to the amount of benefit it receives from the construction of the ditch or drain and not because it is nearer the outlet than some other tract, and hence can secure this benefit at a lesser cost. If the land already has an outlet, it will not be benefited and should not be included in the district. The land at the lower end of the drainage district near the outlet is usually drier than that farther up and would not be taxed so much for this reason but if the lands are of a like character in other respects, both as to kind and degree, there will be no difference in the benefits received because one tract happens to lie farther up the ditch from the outlet than the other. The only exception that should be made from this general statement is in case of a tract lying near the natural outlet so that it may be drained independently of the drainage district at a less cost than would be assessed against it if included in the drainage district. In such case it might have a reduction in its assessment because of its location as a matter of equity but not because the drainage law authorizes it.

Degree of Wetness.—The next element and by far the most important one which enters into the determination of the benefits is the degree of wetness. This may vary all the way from an absolute swamp at all times of the year to land that is too wet for cultivation at certain seasons,

and since the primary object of drainage is to remove the excess of moisture and render the land fit for cultivation at all times and seasons, the degree of wetness or the amount of moisture to be removed is a matter that should receive the closest and most discriminating attention. If a 40-acre tract is not all of equal wetness it will often be found advantageous to subdivide it into two or more parts so as to get the number of acres representing the varying degrees of wetness.

Fertility of the Soil.—Another element which should not be lost sight of in making this classification is the fertility of the soil. Lands in the proposed district may be of an equal degree of wetness, may have the same elevation, and be situated the same distance from the proposed ditch and yet not receive the same amount of benefits from the construction of the improvement. It is not uncommon to find in the same marsh tracts of rich, black, alluvial soil and others of a whitish clay substance devoid of fertility and frequently known as sand flats. In such a case the fertile land would be greatly enhanced in value by proper drainage, while the other would be worth but little, even when drained. This is an extreme case, but in practically every drainage district there is a wide difference in the fertility of the soil, and the soil that is most fertile will as a rule be most benefited by drainage.

Condition of the Surface.—Some tracts possess a uniform, smooth surface, while others are traversed by old channels, rock-ledges, coulees, and crooked bayous, and even when drained all of the surface cannot be put in cultivation. This, however, is a condition not likely to be changed by drainage, and should not be taken into account in assessing the benefits. If the surface of the land is cut up or marred by the construction of the improvement, this is a proper matter to be considered in the assessment of damage but not the benefits.

Healthfulness.—Experience throughout the country has proven beyond a doubt that drainage improves the healthfulness of the community. It renders less prevalent disease of a malarious type and makes fit for habitation lands that otherwise could not be occupied. Wherever large areas of swamp lands have been drained the general healthfulness of the locality has been improved, and as a consequence, the market value of the land is increased. This is the result of the drainage of the land and should be taken into account in making the assessment of benefits.

The natural attributes of the land which are clearly changed by drainage are:

1. Degree of wetness.
2. Proximity to the ditch.
3. Fertility of the soil.
4. Conditions as to healthfulness.

These factors are not of equal importance in determining the assessment, so in order to get some plan that will produce a just and equitable result, it is suggested that the degree of wetness be given a value ranging from 0 to 40 points; that proximity be given a value ranging from 0 to 30 points; that fertility of the soil be given a value of 0 to 20 points; and general healthfulness a value of 0 to 10 points. Thus, in making a classification, the viewers would mark the wettest piece of land in the district 40 points, and all others having the same degree of wetness the same amount, while others having a lesser degree of wetness would be marked in points corresponding to their degree of wetness as compared with the first tract.

If some tract is adjacent to the ditch or the ditch passes through it, it would be marked 30 points for proximity; while other tracts would have a correspondingly less number of points, depending upon their distance from the ditch. If this first tract were extremely fertile, it would be marked 20 points on the basis of fertility, while a less fertile tract would be marked lower in a corresponding ratio. If it is thought that the proposed work will improve the sanitary conditions of one part of the district more than another, then the land would be marked from 0 to 10, according to the degree of benefits to the health that the viewers might think it would receive. When the several tracts are viewed and the points of benefit marked against them the total against each tract will be anywhere for 0 to 100 points, which will represent the relative amount of benefits each tract should be assessed for the construction of the proposed improvement.

The map shown represents a proposed drainage district. The wet area comprises the greater part of the township and has a good natural outlet in Juniper Creek on the south. The elevation of the surface is shown by the contour lines. The center of the tract is an open marsh having a sluggish current flowing in times of high water in a tortuous course towards the river. The channel near the river is well defined but must be made much deeper to afford an adequate outlet to drain the marsh. The land near the outer edge of the district is in cultivation, but is too wet to produce good crops and has not sufficient outlet for tile drainage. The character of the land is indicated by the symbols on the map. The soil is a deep, black loam, underlaid with clay except portions in sections 22, and 23, which is a fine, white, sandy clay with little or no vegetable matter in it. The black land is extremely fertile and when drained will be very productive, while the white clay land is lacking in fertility and will require special treatment to bring about any great degree of productiveness.

On this statement of facts it is proposed to classify this land and assess

the benefits for the construction of a proposed drain, as indicated on the map. The ditch will follow the general course indicated and will be deep enough to afford an outlet to thoroughly drain every part of the district.

In accordance with the suggestions above made, we will select four tracts of land located in different parts of the district and mark them respectively A, B, C, and D, and classify them so as to make an assessment for their part of the cost of the ditch in proportion to the benefits received from its construction. We will first examine these tracts with reference to their degree of wetness. The northeast quarter of section 8, marked A, being in the center of a slough, is practically covered with water all the year and therefore possesses the highest degree of wetness, so we will mark it 50 points. The southeast quarter of section 15, marked B, is almost as wet as A, but has a slightly defined channel through it, so we will mark it 35 points. The southeast quarter of section 22, marked C, lies at a greater elevation, a portion of it being comparatively dry, so we will mark it 15 points. The southeast quarter of section 33, marked D, is nearer the river, and the natural outlet has a little better natural drainage and is not so wet as tracts A and B, so we will mark it 20 points.

Now we will view these same tracts with reference to their proximity to the ditch. In other words, we wish to note whether by the construction of this ditch they are brought any nearer to an adequate outlet. Tract A has the ditch brought within a few rods of it, and we will therefore mark it 28 points. The main outlet is improved and deepened and brought nearer to tract B, but an additional ditch will have to be dug before advantage can be taken of this outlet, so we will mark it on proximity 15 points. Tract C, being still farther away, will be marked 12 points, while tract D, which is very close to the ditch, will be marked 28 points.

We will next mark these several tracts on the basis of fertility. Tract A being in the marsh and all of black alluvial land will be when drained extremely fertile, and, therefore, we will mark it 20 points. The same is true of tract B. Tract C is in the nature of a whitish clay, with fine sand mixed with it but is not fertile, so we will mark it 10 points. Tract D is more fertile than C, but probably less fertile than A and B, so we will mark it 15 points.

These several tracts all being situated in the same marsh will, when drainage is accomplished, receive the same amount of benefits as to the degree of healthfulness, so we will mark them each 10 points. Now, by adding the points of benefit assessed against the several tracts we have

the relative benefit each will receive from the construction of the ditch. Performing this addition we find that

Tract A has 98 points.

Tract B has 80 points.

Tract C has 47 points.

Tract D has 73 points.

Then the assessment made against these tracts should be in the proportion of 73, 47, 80, and 98. Each of the other tracts in the drainage district should be treated in the same manner, and in many instances it will be found advisable to divide the sections into 40-acre tracts, and sometimes these 40-acre tracts may be subdivided in order to get the proper amount of the different classes of lands. When this classification is made the results should be entered in the commissioners' field book, as shown by the sample page submitted herewith. This book when completed shows the relative amount of benefits that each tract in the drainage district will receive as compared with all other tracts in the district, but does not show the sum in dollars and cents that it will be assessed for the construction of an improvement. This can be determined by the county auditor or the drainage commissioner in the manner hereinafter explained.

A report prepared in this manner will inspire confidence and carry weight with it. Any landowner may see what class his land is in and ascertain by an inspection of the report why it was placed in that class. This would be much more satisfactory than to have the land returned with an assessment of so many dollars marked against it without any indication of how such a sum was determined.

After having determined by the above method in what proportion the assessment should be made against the several tracts, it is next in order to determine how much of the total cost each tract should be assessed. Before doing this, however, it is necessary to determine the assessment against the public at large and against the railroads and the interurban lines, if there be any. The assessment against the farm lands attach to the reality itself and not to the owner and if not paid when due, the land can be sold to enforce the payment of the assessment, but not so with an assessment against the general public or the railroad. This is more in the nature of a personal obligation; it is a debt against a corporation and not a lien on any particular part of the roadbed or track and can be collected only as other debts are collected.

If the road-bed of any railroad or interurban line is improved by affording better drainage, the railroad will be benefited by the construction of

the drain and should be assessed therefor, but an assessment should not be levied against a railroad in view of the fact that when farm lands are drained it will have an increased tonnage of freight to haul from the district or that towns and villages will spring up, and it will have an increased revenue from the passenger and express business. This is part of the benefit that accrues to the public at large as a result of drainage. A railroad may be viewed as integral part of this community and should not be subject to a special assessment any more than a merchant or manufacturer who will secure an increased sale for his wares because of the increase in the growth of the community. The assessment against railroads should, therefore, be confined to and based on the improvement or benefit to their material property.

Under the Indiana law, the ninth cause for remonstrance is that the proposed work will neither improve the public health nor benefit any public highway of the county, nor be a public utility. If this be true no public drain will be established, as it is to serve this public function that drainage districts are organized. The public, then, being benefited, should pay a portion of the cost of the work. The law does not specify as to what degree the public must be benefited in order to warrant the creation of a drainage district, but it has been repeatedly held by the courts that some degree of public benefit must be proved before the drain may be established. This leaves it, then, with the viewers to determine the amount of such benefit. It may be a mere nominal sum or it may be a large amount, owing to the character, location, and extent of the lands to be drained. If the area to be drained should be large, extremely swampy, and malarious, the high land adjacent thickly populated, and the roads crossing the swamp, connecting different parts of the locality, impassable at certain portions of the year, the resulting benefit to the community would be large and the assessment against the township or county should be in proportion to the benefit. A small drain in a well-improved agricultural country to serve a limited territory might be of little use to the general public and the assessment against the town or county for its construction should be correspondingly small. There is no rule governing this matter as each particular case must be viewed and treated separately in the light of the surrounding conditions. The assessment against the township or county because of the public utility and the assessment against the several railroads and interurban lines having been determined, this amount should be deducted from the entire cost of the improvement and the remainder of the cost distributed over the lands benefited.

Having determined the proportion of the total cost to be paid by the landowners, it can be distributed by an accountant in the following manner:

Assume an assessment of as many mills per acre against each tract of land as it has points of benefit and multiply this by the number of acres in the tract, for a basis assessment. Thus, in the illustration given above, A has 98 points, B 80 points, C 47 points, and D 73 points. Now assume an assessment of 98 mills per acre against A, 80 mills per acre against B, 47 mills per acre against C, and 73 mills per acre against D, and multiply these several amounts by the number of acres in the tract. We will then have; for A, a basis assessment of \$15.68; \$12.80 against B; \$7.52 against C; \$11.68 against D. Adding these, we have as the sum of the basic assessments, \$47.68. This is not as high as the assessment will have to be made on these several tracts, but if we divide the entire cost of the work by this amount it will show how many times they will have to be repeated; hence, we divide the entire cost of the work by the sum of these basic assessments and the quotient will be a coefficient showing how many times these basic assessments will have to be repeated to produce the entire amount required.

If these were the only four tracts in the district and the total cost of the work was \$3,432.96, then to ascertain what part of this cost should be assessed against each tract we would divide \$3,432.96 by \$47.68, the sum of the basic assessments, and it would give a quotient of 72, which is the coefficient showing how many times these basic assessments must be taken. By multiplying the basic assessment on each tract by this coefficient, we get the entire assessment on each tract. Thus the basic assessment on tract A, \$15.68 multiplied by 72, gives \$1,128.96, the entire assessment on tract A; tract B, \$12.86 multiplied by 72, gives \$921.60, the entire assessment on tract B; tract C, 7.52 multiplied by 72, gives \$541.44, the entire assessment on tract C; and tract D, \$11.68, multiplied by 72, gives \$841.96, the entire assessment on tract D. Adding these several assessments we get \$3,432.96, the cost of the work, to be paid by all of these tracts. In case it is ever required to raise an additional sum to meet some unforeseen expense, it can be apportioned in the same manner.

The method here suggested may not be perfect, but has the advantage of being based on some principle, and will surely give more uniform results than a mere guess. In the modern judging of stock, corn, or other products a score card is used indicating the points to be considered and giving the maximum value that should attach to each of these points. In a competitive contest of any kind much more satisfactory results can be ascertained when the marking is based on certain designated points of efficiency or scale.

Where several points are to be taken into consideration and determined

by a matter of judgment, if one is considered too high another is just as likely to be marked too low, and on the whole the average is more likely to be correct than if the judgment is predicated on a single point. In your experience, you may find it advisable to give different values than those suggested in this paper to the several attributes to be taken into consideration, but I would earnestly recommend that this or some similar method of assessing benefits be adopted.

JUPITER CREEK DRAINAGE DISTRICT.

SPECIMEN PAGE.

FORM OF COMMISSIONERS' RECORD BOOK OF ASSESSMENTS.

JUPITER CREEK DRAINAGE DISTRICT.

SEPTEMBER 25, 1907.

Name of Owner.	Number of Acres.	Description.	Points of Benefit.	Basic Assessment.	Coefficient.	Total Assessment.
A	160	NE. $\frac{1}{4}$ Sec. 8	98	\$15 68	72	\$1,128 96
B	160	SE. $\frac{1}{4}$ Sec. 15	80	12 80	72	921 60
C	160	SE. $\frac{1}{4}$ Sec. 22	47	7 52	72	541 44
D	160	SE. $\frac{1}{4}$ Sec. 33	73	11 68	72	840 96
	640			\$47 68		\$3,432 96

SPECIMEN PAGE.

FORM OF DRAINAGE COMMISSIONERS' FIELD BOOK OF CLASSIFICATION.

JUPITER CREEK DRAINAGE DISTRICT.

SEPTEMBER 25, 1907.

Name of Owner.	Number of Acres.	Description.	Points of Benefit.				
			Wetness 0-40	Proximity 0-80	Fertility 0-20	Health 0-10	Total 0-100
A	160	NE. $\frac{1}{4}$ Sec. 8	40	20	16	16	98
B	160	SE. $\frac{1}{4}$ Sec. 15	35	15	20	10	80
C	160	SE. $\frac{1}{4}$ Sec. 22	15	12	10	10	47
D	160	SE. $\frac{1}{4}$ Sec. 33	20	28	15	10	73

PUBLICATIONS
OF THE
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BULLETINS.

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VOLUMES.

- Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 50 cents extra.*
- Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 50 cents.*
- Vol. III. Miscellaneous Mineral Resources in North Carolina, by Joseph Hyde Pratt. *In preparation.*

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of *postage* needed, as indicated above, for mailing the bulletins desired, to the *State Geologist, Chapel Hill, N. C.*

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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

ECONOMIC PAPER No. 18

PROCEEDINGS

OF

SECOND ANNUAL DRAINAGE CONVENTION

HELD AT

NEW BERN, NORTH CAROLINA

NOVEMBER 11 AND 12, 1909

COMPILED BY

JOSEPH HYDE PRATT

AND

NORTH CAROLINA DRAINAGE LAW



RALEIGH

E. M. UZZELL & Co., STATE PRINTERS AND BINDERS

1909

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LETTER OF TRANSMITTAL.

CHAPEL HILL, N. C., December 1, 1909.

To His Excellency, Hon. W. W. KITCHIN,

Governor of North Carolina.

Sir:—On November 11th and 12th there was held at New Bern, North Carolina, one of the most important conventions that has been held in the State during the past year. This was the Drainage Convention held under the auspices of the North Carolina Drainage Association. On account of the importance of this convention to the subject of drainage in North Carolina and the close co-operative work the North Carolina Geological and Economic Survey has carried on with the Drainage Association, I recommend that the proceedings of this convention be published as Economic Paper No. 18, of the publications of the North Carolina Geological and Economic Survey.

Yours respectfully,

JOSEPH HYDE PRATT,

State Geologist.

N. C. Geological Survey 12-31-12

CONTENTS.

	PAGE.
Introduction	7
Proceedings of the Convention.....	8
Morning Session, November 11th.....	8
Address of Welcome by C. J. McCarthy.....	8
Appointment of Committees.....	10
Practical Results of the Drainage of Swamp Lands, by J. O. Wright	10
Discussion of Address.....	16
Afternoon Session, November 11th.....	16
Land Drainage from an Engineering Standpoint, by E. W. Myers..	16
Is the Drainage of North Carolina Swamp Lands Practicable? by Joseph Hyde Pratt.....	20
Discussion	21
Night Session, November 11th.....	22
Morning Session, November 12th.....	23
Report of Committee on Nominations.....	23
Afternoon Session, November 12th.....	25
Report of Committee on Resolutions.....	25
Discussion of North Carolina Drainage Law.....	28
Counties Represented at Convention.....	29
North Carolina Drainage Law.....	31
Instructions and Suggestions to Engineers and Viewers in Connection with the Establishment of Drainage Districts in North Carolina, by Joseph Hyde Pratt	47

PROCEEDINGS
OF THE
SECOND ANNUAL DRAINAGE CONVENTION,

HELD UNDER THE AUSPICES OF THE

NORTH CAROLINA DRAINAGE ASSOCIATION.

NEW BERN, N. C., NOVEMBER 11 AND 12, 1909.

COMPILED BY
JOSEPH HYDE PRATT, STATE GEOLOGIST.

INTRODUCTION.

The first Drainage Convention held in North Carolina was at New Bern, in September, 1908. This convention adopted resolutions endorsing a drainage bill which it believed would make possible the drainage of thousands of acres of swamp and overflowed lands in North Carolina, and also resolved itself into a permanent organization to be known as the North Carolina Drainage Association. The final result of this first convention and the organization of the Drainage Association was the passage of the North Carolina Drainage Act by the Legislature of 1909. That the passage of this act was a wise measure, and one that will be the means of bringing under cultivation thousands of acres of swamp lands in eastern North Carolina, and overflowed lands in the Piedmont and Mountain regions is evidenced by the fact that since its passage twelve drainage districts have been formed or are in the process of formation.

These drainage propositions, which undertake the drainage of thousands of acres of swamp land, are large undertakings, and can be accomplished only by the combined efforts of those owning the land. The success of the proposition depends upon the wise expenditure of thousands and sometimes hundreds of thousands of dollars, and, for that reason, the North Carolina Drainage Law contains provisions so that no drainage under this law can be undertaken until it has been definitely proved by surveys that the proposition is feasible, and that the cost of the drainage is not greater than the benefits that the land will derive from its drainage. As yet, this Drainage Law is not thoroughly under-

stood, and many of our larger farmers have an idea that they could drain their own lands cheaper and perhaps better than by becoming part of a drainage district; while, on the other hand, the small farmer who owns but a few acres of land has an idea that he will be unjustly taxed if he enters a drainage district, and have to bear a large proportion of the cost of the drainage. Both of these classes of men have a misconceived idea of the Drainage Law, which very carefully safeguards the interests of the small farmer as well as the larger farmer. It is absolutely impossible for the farmer owning 10,000 to 20,000 acres of land to drain this as satisfactorily by himself as by the formation of a drainage district.

There is given at the end of the report of the proceedings a copy of the North Carolina Drainage Act.

To this Second North Carolina Drainage Convention which was held under the auspices of the North Carolina Drainage Association delegates were appointed from the following counties in eastern North Carolina: Currituck, Pasquotank, Perquimans, Chowan, Dare, Tyrrell, Washington, Bertie, Martin, Pitt, Beaufort, Hyde, Pamlico, Craven, Gates, Jones, Onslow, Carteret, Lenoir, Duplin, Pender, Hertford, Sampson, Bladen, Robeson, Columbus, Cumberland, Brunswick, New Hanover, Greene, Edgecombe, Wilson.

The mayors of all the towns in these counties were also appointed delegates, and the Governor appointed eighty-four delegates at large in the State.

PROCEEDINGS OF THE CONVENTION.

MORNING SESSION, NOVEMBER 11.

The first meeting was called to order on Thursday morning, November 11th, at 10:30 o'clock, by John Wilkinson, president of the North Carolina Drainage Association, who called upon Rev. J. H. Brown, rector of Christ's Church, to offer prayer.

The chairman of the convention then called upon Hon. C. J. McCarthy, Mayor of New Bern, who welcomed the delegates to the city.

ADDRESS OF WELCOME BY C. J. MCCARTHY.

Mr. President, Delegates of the North Carolina Drainage Association.

GENTLEMEN:—I come to you this morning in behalf of the city of New Bern to welcome you in our midst. Yes, gentlemen, I come in behalf of the "Athens of the Old North State" to extend to the North Carolina Drainage Association a most cordial welcome.

Esteemed guests, my welcome goes still deeper, for I introduce you into the hearts and homes of my people, of whom, if I should try to give the praise that is due them, words and eloquence would fail me. Our people have only one desire while you are in their midst, and that is to make your stay one of continuous enjoyment.

And while this is a duty of joy and pleasure to us, it will be your opportunity to solve a problem which, if accomplished, will be one of the grandest achievements that ever happened for this section of the State.

The drainage of the lowlands in our section not only means gold and silver to us, but it means more—it means draining away the stagnant waters whose unwholesome vapors are such a menace to this section. We are not unmindful, gentlemen, that the undertaking of this great and noble enterprise will require earnest thought and the expenditure of some money, but with the co-operation that you have here to-day, nothing but success can follow. Let me conclude by repeating a verse that I heard a small child recite a few days ago, and which reminds me of this intended undertaking:

"One step, then another, and the longest walk is ended ;
One stitch, then another, and the largest rent is mended ;
One brick, then another, and the highest wall is made ;
One flake upon another, and the deepest snow is laid.

"Then do not frown or murmur at the work you have to do,
Or say that such a mighty task you never can get through.
But try in earnest day by day another point to gain ;
And soon the lowlands which you feared will prove to be all drained."

The following committees were then appointed:

Committee on Resolutions: Ernest Green, of New Bern, chairman; John H. Small, Washington; W. S. Chadwick, Beaufort; Joseph A. Brown, Chadbourn; S. W. Everett, Oriental; G. B. McLeod, Lumberton, and Walter Jones, Swanquarter.

Committee on Nominations and Place of Next Meeting: B. F. Keith, of Wilmington, chairman; C. R. Thomas, New Bern; T. H. B. Gibbs, Fairfield; H. K. Wolcott, Norfolk; C. R. Humphries, Wilmington; A. B. Lukens, Moyock, and John S. Morton, North Harlowe.

The next speaker was Mr. J. O. Wright, Supervising Drainage Engineer of the United States Department of Agriculture, who spoke on the subject of the practical value of drainage. Mr. Wright's talk was illustrated with charts and diagrams which added very much to the interest and value of his paper.

PRACTICAL RESULTS OF THE DRAINAGE OF SWAMP LANDS.

By J. O. WRIGHT.

There is published in the November number of "World's Work" an article by James J. Hill, who has probably done more than any other man to develop the farm lands of the great Northwest. In this article Mr. Hill shows conclusively that agriculture has not kept pace with the growth of the country in other respects. The increase in population, manufactures, and commerce have far outstripped the increase in agricultural products. Since 1880 our population has increased 74 per cent and the growth of wheat only 41 per cent. During this period the wheat-producing area has moved westward, thus increasing the acreage, while the average yield per acre has steadily decreased.

The same thing is practically true of corn. In 1880 the corn crop was 1¾ billion bushels, while in 1908 it was 2½ billion bushels, being an increase of about 54 per cent. The extension of the corn belt has reached its limit. There are no more corn-producing States to be settled and brought into cultivation. The peculiar soil and climatic conditions necessary to grow good corn are confined to a much smaller area than the wheat-producing section. There is no foreign country from which corn can be imported. Its growth is practically restricted to the Mississippi Valley and the Atlantic Coast States. Because of shiftless and profligate methods of farming, the yield of corn per acre is gradually decreasing in a number of the States. Twenty years ago the people of Illinois boasted of the inexhaustible fertility of their black prairie soil, and continued to grow corn on the same land year after year until they became alarmed at the constantly decreasing yield. Experiments show that twelve years' cropping, where corn followed corn, reduced the yield from 70 to 35 bushels per acre. This means that the middle West has reached its zenith as a corn-producing section. If the yield per acre is to be maintained, some form of crop rotation must be practiced. This will reduce the acreage in this section.

My object in calling attention to this condition is to impress upon you the fact that good corn land is the very best asset that a State or an individual can possess. It is growing scarcer and scarcer each year and will always command a very high price. Good corn land to-day, whether in Iowa, Illinois, or North Carolina, is worth upwards of \$100 per acre. In the article above cited, Mr. Hill presents a map of the United States showing graphically the area of the several States and the amount of improved and unimproved farm land. With the exception of Florida and the arid States, North Carolina has the smallest per cent of improved land of any State in the Union. With her 31,000,000 acres extending from Currituck to Cherokee, there were in 1900 but 8,000,000 acres of improved farms.

Of this vast area of unimproved land, I wish to call your attention to the 3,000,000 acres of swamp and overflowed land scattered along the Atlantic coast from Virginia to South Carolina. The fertility of this vast area is unsurpassed. Enough has been reclaimed and put in cultivation to demonstrate that it is pre-eminently a corn soil. The greatest yield of corn ever produced on an acre of land was grown in the Carolinas. God has provided the soil, the rain, and the sunshine, and if man were to do his part there could be established here a corn belt that would surpass the richest parts of Indiana or Illinois.

North Carolina, at the present time, produces 2.7 per cent of the entire corn crop of the United States. If these swamp lands were thoroughly drained and properly cultivated, they alone could be made to produce a crop of corn equal to 10 per cent of all the corn raised in the United States this year. It is my purpose to-day to discuss with you the reclamation of these lands, and let you decide whether it will pay to drain them or not. From my personal knowledge of these swamp lands, I think they may be properly divided into three great classes:

First, the great area of gum and cypress swamp. This land is distributed over a large portion of the eastern part of the State, either in long, narrow belts, ranging from one-quarter mile to two miles in width, or in extensive areas several miles in diameter. It was originally heavily timbered in gum, cypress, maple, poplar, ash, and other soft woods. Most of this timber has been removed or is under contract to be removed in the near future. This type of land does not reforest readily and is especially suited for agriculture. When the timber is removed it has a speculative value of from \$3 to \$8 per acre, according to location, but yields no revenue whatever to the owner.

A second type is the open marsh, commonly called bay or pocoson. It is found in large areas in Washington, Tyrrell, Dare, Pamlico, Craven, Jones, Onslow, and Pender counties. It is a muck soil, varying in depth from 1 to 10 feet. There is but little timber on these lands, and that is of poor quality. In its present condition this land is absolutely worthless. It is even too wet and boggy for grazing. What it needs is deep drainage, and, as it settles, to be pastured with cattle, sheep, and goats. It is not a well-balanced soil, but when thoroughly drained and limed it produces good crops.

The third type and by far the most important one is the extensive area of poorly drained cleared land. The farms are cultivated in a shiftless way and yield a scant income when the season is favorable. Such farms are common in all parts of eastern North Carolina. Some of them have been cleared and

in cultivation for 100 years, and are not yet brought to a paying basis. If the owners grow a good crop one year, they are likely to lose the next three from lack of adequate drainage. This takes away all the profit in farming such lands.

Hyde County furnishes a marked example of this type. For the past three years the profits have been literally drowned out, while for this year there has been just the right amount of rain at the proper time and the crops are excellent. If the people of Hyde could have a good crop, such as the present one, each year, they would soon grow to be the richest people in the State. It is the certainty of a good crop each year that brings prosperity.

From Moyock to Edenton there is scarcely a farmer that has made half a crop for the past four years. They have ploughed and planted, but reaped not. The seed potatoes rotted in the ground and the corn and cotton stood in the water until their growth was checked or they turned yellow and died. Such farms are not a profitable investment, and a community of such farms is not a prosperous community. Without drainage these lands will remain cheap, and the living that can be wrested from them by hard work will be a cheap living. With proper drainage, good seed, and better methods of cultivation, this type of land can be made a most profitable investment.

To get the profit in drainage before you in the most striking manner, I have prepared some tables dealing with the three types of land in eastern North Carolina requiring drainage. The figures used are the average of a number of examples taken from actual practice. Example No. 1 deals with 40 acres of gum swamp from which the merchantable timber has been removed.

For the benefit of those who are not acquainted with the method of clearing and cultivating land in eastern North Carolina, I will explain what is meant by "stuck corn." When a piece of swamp is drained and the merchantable timber removed, the remaining growth is cut close to the ground and caused to fall flat and trimmed so as to lie close and make a uniform covering on the land. This work is usually done during the fall or winter. In the following spring when it is well dried out it is fired at various points and completely burned over. This burning not only destroys all the leaves, brush and most of the trunks, but also every sprig of green vegetation and all the weed and grass seeds on the land. Without any further preparation the land is then staked off in rows the proper distance apart and corn is planted by making holes with a stick about one foot apart and putting in a grain of corn and covering it with the foot. The corn requires no cultivation and often makes 50 bushels per acre. The success of this method depends largely upon getting a good burn on the lands. Great care should be taken to keep the fire out of the woods until such time as it is desired to make the "burn."

EXAMPLE No. 1.

PROFIT AT THE END OF FIVE YEARS IN RECLAIMING 40 ACRES OF GUM SWAMP UNDER THE STATE DRAINAGE LAW AND CULTIVATING SAME IN CORN.

		Cost.	Income.
FIRST YEAR.			
40 acres swamp at \$5 per acre	\$ 200.00		
First payment of interest on drainage bonds	9.60		
Amount invested at end of year		\$ 209.60	
SECOND YEAR.			
During this year the outlet canal should be completed.			
Cutting down growth on 40 acres at \$7 per acre	\$ 280.00		
Digging 640 rods open ditch at 30 cents	192.00		
Second payment of interest	9.60		
		481.60	
Amount invested at end of second year		\$ 691.20	
THIRD YEAR.			
Crop of stuck corn is to be given this year; yield to be expected 50 bushels per acre—2,000 bushels.			
8 bushels seed corn at \$1 per bushel	\$ 8.00		
Planting 40 acres at \$1.25 per acre	50.00		
Chopping out once, 20 days at \$1	20.00		
Gathering 2,000 bushels at 6 cents per bushel	120.00		
First installment drainage tax	16.00		
Third installment interest on bonds	9.60		
		228.60	
Amount invested at end of third year		\$ 914.80	
2,000 bushels corn at 70 cents per bushel			\$ 1,400.00
FOURTH YEAR.			
Crop of corn to be cultivated; yield to be expected, 60 bushels per acre—2,400 bushels.			
Cutting and burning logs, \$6 per acre	\$ 240.00		
Cleaning out field ditches, 10 cents per rod	64.00		
Planting and cultivating 40 acres at \$3 per acre	320.00		
Gathering 2,400 bushels at 4 cents per bushel	96.00		
Fourth installment drainage tax	16.00		
Fourth payment of interest on bonds	8.64		
		744.64	
Amount invested at end of fourth year		\$ 1,659.44	
2,400 bushels corn at 70 cents per bushel			1,680.00
FIFTH YEAR.			
Crop of corn to be grown and, when laid by, sown in cowpeas; yield to be expected, 60 bushels of corn per acre—2,400 bushels corn and 30 tons pea hay.			
Removing and burning small stumps	\$ 160.00		
Planting and cultivating corn	320.00		
Gathering 2,400 bushels at 4 cents	96.00		
50 bushels cowpeas at \$1.75 per bushel	87.50		
Harvesting 40 acres cowpeas at \$4 per acre	160.00		
Fifth installment drainage tax	16.00		
Fifth payment of interest on bonds	7.68		
		847.18	
Amount invested at end of fifth year		\$ 2,506.62	
2,400 bushels corn at 70 cents			1,680.00
30 tons cowpea hay at \$15 per ton			450.00
Total income at end of fifth year			\$ 5,610.00
Value of land at end of fifth year			2,400.00
Total income from transaction			\$ 7,610.00
Less amount expended			2,506.62
Net profit for five years			\$ 5,103.38

EXAMPLE No. 2.

PROFIT AT THE END OF FIVE YEARS IN RECLAIMING 40 ACRES OF OPEN MARSH OR POCOSON
UNDER THE STATE DRAINAGE LAW AND CULTIVATING SAME IN CORN AND COWPEAS.

FIRST YEAR.		Cost.	Income.
40 acres of open marsh at \$2 per acre	\$ 80.00		
First payment of interest on drainage bonds	6.00		
Amount invested end of first year		\$ 86.00	
SECOND YEAR.			
Outlet should be completed so that field ditches may be dug. 800 rods of field ditch with earth scraped back from edge, at 37 cents per rod			
Liming 40 acres at \$5 per acre	\$ 296.00		
Second payment of interest on bonds	200.00		
	6.00		
Amount invested end of second year		502.00	
		\$ 588.00	
THIRD YEAR.			
Crop of corn should be grown; yield to be expected, 40 bushels per acre—1,600 bushels. Planting and cultivating 40 acres corn at \$7 per acre			
Gathering 1,600 bushels at 4 cents per bushel	\$ 280.00		
First installment of drainage tax	64.00		
Third payment of interest on bonds	10.00		
	6.00		
Amount invested at end of third year		360.00	
1,600 bushels corn at 70 cents per bushel		\$ 948.00	\$ 1,120.00
FOURTH YEAR.			
Crop corn and cowpeas. Growing 40 acres corn at \$6 per acre			
50 bushels cowpeas at \$1.60 per bushel	\$ 240.00		
Gathering corn, 1,600 bushels, at 4 cents	80.00		
Harvesting 40 acres pea hay at \$4 per acre	84.00		
Liming 40 acres at \$3 per acre	160.00		
Second installment of drainage tax	120.00		
Fourth payment of interest on bonds	10.00		
	5.40		
Amount invested end of fourth year		679.40	
1,600 bushels corn at 70 cents		\$ 1,627.40	1,120.00
40 tons pea hay at \$15 per ton			600.00
FIFTH YEAR.			
Crop of corn and cowpeas. Growing 40 acres corn at \$6 per acre			
50 bushels cowpeas at \$1.60 per bushel	\$ 240.00		
Gathering corn, 2,000 bushels, at 4 cents	80.00		
Harvesting 40 acres pea hay at \$4 per acre	80.00		
Third installment drainage tax	160.00		
Fifth payment of interest on bonds	10.00		
	4.50		
Amount invested end of fifth year		574.80	
2,000 bushels corn at 70 cents		\$ 2,202.20	1,400.00
50 tons pea hay at \$15 per ton			750.00
Total income			\$ 4,990.00
Less total investment			2,202.20
40 acres of land at \$50 per acre			\$ 2,787.80
Net profit for five years			2,000.00
			\$ 4,787.80

EXAMPLE No. 3.

PROFIT AT THE END OF FIVE YEARS FROM IMPROVING A POORLY DRAINED 40-ACRE FARM AND GROWING COTTON, CORN, COWPEAS AND IRISH POTATOES—GENERAL DRAINAGE TAX \$3.20 PER ACRE.

FIRST YEAR.		Cost.	Income.
40 acres cleared land at \$25 per acre -----	\$ 1,000.00		
First payment of interest on drainage bonds -----	7.68		
Amount invested end of first year -----		\$ 1,007.68	
SECOND YEAR.			
Outlet canal completed so crop can be grown.			
800 rods field ditch, 25 cents per rod -----	\$ 200.00		
Scraping back spoil bank -----	40.00		
Growing and marketing 40 acres cotton at \$15 -----	600.00		
Second payment of interest on drainage bonds -----	7.68		
		847.68	
Amount invested end of second year -----		\$ 1,855.36	
Returns—30 bales cotton at 10 cents per pound -----			\$ 1,500.00
THIRD YEAR.			
Growing and harvesting 40 acres corn at \$7.60 -----	\$ 304.00		
Commercial fertilizer at \$4 per acre -----	160.00		
50 bushels peas or soy beans -----	75.00		
First installment drainage tax -----	12.80		
Third payment of interest on bonds -----	7.68		
		559.48	
Amount invested end of third year -----		\$ 2,414.84	
Returns—1,600 bushels corn at 70 cents -----			1,120.00
50 tons pea hay at \$15 -----			750.00
FOURTH YEAR.			
Crop Irish potatoes followed by peas and millet.			
Growing and marketing 40 acres potatoes at \$60 -----	\$ 2,400.00		
Peas and millet seed -----	80.00		
Harvesting hay crop, \$4 per acre -----	160.00		
Cleaning out field drains -----	80.00		
Second installment drainage tax -----	12.00		
Fourth payment of interest on bonds -----	6.90		
		2,738.90	
Amount invested end of fourth year -----		\$ 5,153.74	
Returns—2,400 barrels potatoes at \$3 -----			7,200.00
80 tons hay at \$20 -----			1,600.00
FIFTH YEAR.			
Growing crop cotton at \$18 per acre -----	\$ 720.00		
Third installment drainage bonds -----	12.00		
Fifth payment of interest on bonds -----	6.12		
		738.12	
Amount invested end of fifth year -----		\$ 5,891.86	
Returns—40 bales cotton at \$50 -----			2,000.00
SUMMARY.			
Total increase for five years -----			\$ 14,170.00
Value of land at end of fifth year -----			2,400.00
Total income for five years -----			\$ 16,570.00
Less total expenses for five years -----			5,891.86
Net profit for five years -----			\$ 10,678.14

Discussion of Address.—At the close of Mr. Wright's address Mr. Wilkinson paid a very high tribute to the work that Mr. Wright had done in eastern North Carolina, stating that the interest in drainage work in this State, and the work that had thus far been accomplished was largely due to the efforts of Mr. Wright.

This address of Mr. Wright's started a discussion which was entered into with a great deal of enthusiasm by many of the delegates, who took up the questions as to the practicability of the drainage of swamp lands in their sections, and also a discussion of the figures which Mr. Wright used in illustrating his arguments. The consensus of opinion of the delegates was that Mr. Wright's figures were, as a whole, correct, and represented pretty accurately what returns could be obtained by the drainage and cultivation of the swamp lands of North Carolina.

At the conclusion of this discussion the chairman called on Hon. John H. Small, of Washington, N. C., who spoke on "The Significance of the Drainage Movement," and perhaps the keynote of his address was the spirit of unity and co-operation which this great work demands if it is to meet the success that it deserves. He regarded the drainage of our swamp and overflowed lands as one of the more important questions before the public to-day.

The next speaker at the morning session was Hon. W. A. Graham, Commissioner of Agriculture, who spoke briefly on "The Value of Drainage to the Farmers of North Carolina." He expressed the interest of his Department in the work of the convention, and assured the delegates that the Department of Agriculture would assist in every way it could in advancing the cause of drainage in this State.

The morning session adjourned at 1 P. M.

AFTERNOON SESSION, NOVEMBER 11.

The session was called to order by the chairman, and the first speaker was Mr. E. W. Myers, a drainage engineer of Greensboro, N. C., who spoke on the subject, "Land Drainage from an Engineering Standpoint."

LAND DRAINAGE FROM AN ENGINEERING STANDPOINT.

BY E. W. MYERS.

If there are any here unconvinced of the material benefits to be derived from the proper drainage of the swamp and wet lands of North Carolina, I am sure that the arguments and eloquence of those who have spoken to you have brought the waverers over to the true faith.

Many of you have, of course, held the faith for a long time, and a number are showing this faith from their works. Your faith, in drainage at least, must show itself in works if it is to have any effect on your salvation.

Since, then, we are all of one mind about drainage, I am not going to talk to you about the increased crops you can produce, nor of the better roads you will have to travel over, nor of the increased freedom from malarial and other diseases which you will experience when the wet lands in your vicinity are properly drained. Instead, I wish to speak to you for a few minutes of the men on whom you will have to rely to accomplish these ends for you, and of the means whereby these very desirable things are to be brought about.

There are several directions from which the subject of land drainage may be approached, but in essence the matter is one primarily for the agriculturist and the engineer: the one interested in what may be done with the land after it has been drained; the other, first, in what will be required to drain the land, and in the methods and costs of the necessary works.

A talk, therefore, on the subject of land drainage from an engineering standpoint might cover the whole art and science of drainage. The best way to learn about land drainage from all points of view is to do it. That, then, is my advice to you—Go do it; and you will learn much more than any number of speeches or books can teach you. But as much of the necessary work must be done by proxy, I have thought that it might be of interest to consider this feature, which perhaps might better be called the relation of the engineer to a drainage project.

The drainage law under which we are working prescribes that when a drainage project is begun, and after certain preliminaries laid down in the law are complied with, that a competent and disinterested civil engineer shall be appointed, whom, then, with the two viewers appointed at the same time, becomes an investigating committee, searching out all the facts of the case, procuring all necessary information as to the feasibility of the drainage scheme, and reporting all this to the Clerk of the Superior Court of the county according to law.

These positions are of great responsibility, and it seems to me that certain qualifications are necessary in those holding them, the first and most important of which is that they be men of known integrity and firmness of purpose, not to be biased in judgment by any means whatsoever.

The second requisite is that these men should have practical knowledge, and that they should be possessed of good sound common sense—the kind that we usually call “boss sense”—for the fate of the entire matter is with them at this stage, and hangs on the report which they shall make. Just how this is so is set out in the drainage law, with which you are all familiar, and which, therefore, I shall not take up your time by repeating.

And, thirdly, these men should know land, and be able to judge of the improvement in quality which would be caused by the proposed drainage, and then be able to fix this knowledge into definite words and figures for the guidance of the court.

These things apply to engineers and viewers alike; but the engineer must have other qualifications also.

A man who can use the ordinary surveying instruments and survey a farm or lay out town lots, or run a grade with a level, is not necessarily a civil engineer, though every civil engineer must be able to use these instruments and

do these things if necessary; and while in some stages of the project it seems that knowledge of surveying is all that is required, it is not so at any time. It is, of course, important that the lines should be run accurately, but it is of even greater importance that they should be run in the right places to furnish the information desired, and that the information obtained from the surveys and investigations should be correctly interpreted and used; and this very thing involves the distinction between the civil engineer and the surveyor.

There is no good modern definition of what a civil engineer is or does, and those in need of such definition usually fall back on that given in the charter of the Institution of Civil Engineers of Great Britain, the great national engineering society, founded in 1828, which reads:

"The profession of a civil engineer, being the art of directing the Great Sources of Power in Nature for the use and convenience of man, as the means of production and of traffic in States both for internal and for external trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange; and in the construction of ports, harbors, moles, breakwaters and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery, and in the drainage of cities and towns."

Primarily, then, the civil engineer must be a man skilled in the direction of the great forces of nature for the use and convenience of man.

Another and more modern definition of the engineer which is equally true with the one just given is that he must be "a man who can make one dollar do well what the ordinary man could do indifferently with two."

We have, then, for the qualifications of the engineer, integrity of character, sound common sense, knowledge of land as affected by drainage, theoretical and practical knowledge of the economic design and construction of drainage works, and, finally, the executive ability to insure that the works as planned are constructed with all reasonable economy.

These, to my mind, are the essential qualifications that the engineers who take charge of your drainage projects must have. The engineer who has them will save his employers much more than the amount of his fee in the lessened cost of the construction of the work, while the one who does not have them would be expensive if he gave his services for nothing and paid a bonus for the work.

Men who possess these qualifications are, as a rule, successful men, and the time of such men is valuable and commands a high price.

To make an examination of the land in any proposed drainage district and determine the most economic method of draining it, to locate the canals and ditches properly and compute the proper size of each to carry away the water which may reasonably be expected to reach them, to determine the questions of benefits and damages, and to make a just and equitable classification of the lands to obtain money for the construction of the works are tasks which require much time and patient and exhaustive research, and good and competent men, capable of doing these things, cannot be obtained without fair compensation.

The preparation of plans adequate for the needs of the district and the just apportionment of the costs on the lands benefited are matters that should be entrusted only to experienced men, as upon the correctness and efficiency of these works largely depends the ultimate cost and success of the work done.

After the work has been planned, its execution must be properly carried out, and therefore the construction must be supervised by a thoroughly competent man; and this man should be the engineer who prepared the plans and drew up the specifications under which the work is to be done, for a division of responsibility is thus avoided. Common experience in matters of this kind bears out the statement that better results are obtained in this way than are possible in any other.

Now, finally, while in his own estimation every man is more or less of an engineer, with his own opinion as to the best way of performing some proposed work, when your engineer has been selected he has been chosen for his expert knowledge of these very things, and the results you all desire will probably be reached with less cost and with greater satisfaction to all concerned if the engineer be given a free hand in the conduct of the work, so far as this is possible under the law.

There is nothing new in this attitude toward skill. When you are ailing you call in your doctor and follow his instructions, and take his medicines with the confidence that so doing will result in your recovery; and you do this though you may neither understand the reason for the one nor like the taste of the other; you neither advise as to the treatment to be followed nor as to the general conduct of the case, but you hold him responsible for the results. In the same way hold the engineer responsible for results, but let these results be produced in his own way. If your engineer has been wisely selected you may rest assured that a satisfactory drainage project will crown your efforts.

The next speaker was Mr. H. K. Wolcott, of the Norfolk and Southern Railway, who spoke very enthusiastically on the future of North Carolina, his subject being, "The Railroad's Interest in Drainage." He showed that the railroads are not independent of the public, nor the public independent of the railroads, but that both were dependent on each other; and he assured the delegates that as the farmers increased the output of their farms, the railroad would keep in close touch with them and meet their demands. He said their interests were mutual, and that he felt that there would be a close harmony between them which would promote the welfare of each. He stated that he thought in eastern North Carolina there was the greatest opportunity for the farmer of all places in the country, and that the most important step necessary to bring about the increased crops of the farms was drainage. Every swamp land that was drained meant an increased territory that would produce freight to be handled by the railroad, both to and from the farm. Thus any development in the utilization of these swamp lands meant increased traffic to the railroad, and it was, therefore, to the interest of the railroads to do all in their power in the carrying out of these drainage projects.

At the close of Mr. Wolcott's address the chairman called upon Mr. Joseph Hyde Pratt, State Geologist, to lead the discussion—

IS THE DRAINAGE OF NORTH CAROLINA SWAMP LANDS PRACTICABLE?

BY JOSEPH HYDE PRATT.

In opening the discussion, Mr. Pratt called attention to what had been accomplished during the past four years, since the reorganization of the North Carolina Geological Survey by the Legislature of 1905, at which time the Geological Board authorized the State Geologist to begin investigations regarding the value of the swamp lands for agriculture, and the feasibility of draining same. He said:

As the appropriation available for this work was limited, the work had to be carried on slowly, but through a very generous co-operation of the Division of Drainage Investigations of the United States Department of Agriculture the work has been continued and its final results you all know.

The first investigations of the Survey determined:

1. The character of the swamp—whether the soil was suitable for agricultural purposes.
2. Whether the swamp and overflowed lands were suitable for agricultural purposes could be profitably drained.
3. Whether the peat swamps contain a sufficient quantity of this material and of such quality that it could be marketed.

In making these examinations, and in interviews with the people interested, it was found that three obstacles had formerly been in the way of the drainage of these swamp lands: (1) The cost of clearing the land; (2) the excessive cost of digging adequate canals and ditches to take care of the water; (3) lack of adequate laws that would permit the carrying out of the drainage propositions.

Now, however, all these obstacles have been removed, and wherever the land has a sufficient agricultural value to warrant drainage, the drainage proposition can be carried out.

The drainage of these vast swamp areas of eastern North Carolina means not only additional wealth to the State in the form of agricultural lands, but it will mean improved roads through large areas that are now almost impassable and inaccessible. The improved roads will mean better school facilities for the children.

Of the three million acres of swamp land sufficient work has been done to warrant the statement that at least one million acres are of sufficient agricultural value to warrant their being drained.

Although the North Carolina Drainage Act has only been in operation a little over eight months, there are already twelve drainage districts formed or in the process of formation, which include 300,000 acres. These districts are as follows:

- Moyock Drainage District, Currituck County.
- Bear Swamp Drainage District, Chowan County.
- Lake Mattamuskeet Drainage District, Hyde County.

Creswell Drainage District, Washington County.
Rich Square Drainage District, Northampton County.
Dover Drainage District, Craven County.
Pungo Drainage District, Beaufort County.
Lyon Swamp Drainage District, Pender and Bladen counties.
Wilkinson Drainage District, Beaufort County.
White Oak Swamp Drainage District, Bladen County.
Chadbourn Drainage District, Columbus County.
Toisnot Creek Drainage District, Wilson County.
Angola Bay Drainage District, Pender County.

Discussion.—There were representatives from nearly all these districts present at the convention, and Mr. Pratt called upon one or more from each district to state what they were doing, and what had been accomplished in their districts. The following delegates responded: Joseph A. Brown, Chadbourn; Lawrence Brett, Wilson; A. B. Lukens, Moyock; C. R. Vandecarr, Moyock; John A. Wilkinson, Belhaven; T. H. B. Gibbs, Fairfield; Patrick Matthew, Edenton; J. J. Wolfenden, New Bern; B. F. Keith, Wilmington; C. R. Humphries, Wilmington, and P. H. Johnson, Pantego, N. C.

The talks of these gentlemen brought out some very interesting information regarding the work that was being done in these different drainage districts, and illustrated very emphatically the interest that the people have in the drainage of these swamp lands. Already in some of the districts owners of the lands are making arrangements to begin planting, although the drainage work has only been partially completed. There were maps of nearly all these drainage districts on exhibition, and these added a great deal of interest to the talks of the delegates, inasmuch as they showed exactly the location of the districts, the location of the canals, and the mileage of canals necessary to drain certain areas.

Just before the close of the afternoon session the chairman called upon Mr. E. T. Lamb, general manager, Norfolk and Southern Railway, Norfolk, Va. Mr. Lamb in his response showed how vitally interested the Norfolk and Southern Railway was in the drainage of the swamp lands of eastern North Carolina, and stated that he hoped and expected to see the most cordial relations exist between the Norfolk and Southern Railway and the people of eastern North Carolina, as they were very dependent upon each other for maintenance. He stated that the railroad was ready at all times to assist in the development of different sections of eastern North Carolina, and would do whatever was consistent in assisting those who are working out the industrial problems of the State.

At 4:15 the convention adjourned until 8 P. M.

NIGHT SESSION, NOVEMBER 11.

The night session consisted of an illustrated lecture by Mr. Bristow Adams, of the United States Forest Service, on "Conservation." This lecture was largely attended and very instructive.

Mr. M. O. Eldridge, of the Office of Public Roads of the United States Department of Agriculture, had expected to give an illustrated lecture on the "Relation of Drainage to Public Roads," but unfortunately the express company failed to deliver the lantern slides.

SECOND DAY.

MORNING SESSION, NOVEMBER 12.

The morning session of the convention was held on board the revenue cutter "Pamlico," which had been tendered the delegates by the United States Revenue Service for a cruise down the river.

The boat left the pier at 10:10, returning at 12:30.

After the boat had turned around and started on its return trip to New Bern, the chairman called the delegates to order and a short business session was held.

REPORT OF COMMITTEE ON NOMINATIONS.

The Committee on Nomination of Officers and Place of Next Meeting, Mr. B. F. Keith, chairman, reported as follows:

Place for next meeting—Wilmington, N. C.

President—J. A. BROWN, Chadbourn, N. C.

Secretary and Treasurer—JOSEPH HYDE PRATT, State Geologist, Chapel Hill, N. C.

VICE-PRESIDENTS:

Bladen County—A. A. CLARK, Rosindale, N. C.

Beaufort County—JOHN WILKINSON, Belhaven, N. C.

Brunswick County—JACKSON JOHNSON, Town Creek, N. C.

Camden County—W. G. FEREBEE, Gregory, N. C.

Carteret County—W. S. CHADWICK, Beaufort, N. C.

Columbus County—J. P. COUNCIL, Wananish, N. C.

Craven County—C. R. THOMAS, New Bern, N. C.

Currituck County—A. B. LUKENS, Moyock, N. C.

Greene County—D. M. PATRICK, Snow Hill, N. C.

Guilford County—E. W. MYERS, Greensboro, N. C.

Harnett County—H. L. GODWIN, Dunn, N. C.

Hyde County—T. H. B. GIBBS, Fairfield, N. C.

Jones County—J. H. BELL, Pollocksville, N. C.

New Hanover County—B. F. KEITH, Wilmington, N. C.

Onslow County—E. M. KOONCE, Jacksonville, N. C.

Pamlico County—J. F. COWELL, Bayboro, N. C.

Pasquotank County—DR. L. S. BLADES, Elizabeth City, N. C.

Hertford County—R. C. BRIDGER, Winton, N. C.

Chowan County—S. C. PRIVOTT, Edenton, N. C.

Gates County—A. P. GODWIN, Gatesville, N. C.

Pender County—A. B. CROOM, JR., Burgaw, N. C.

Bertie County—SAMUEL FREEMAN, Windsor, N. C.
Robeson County—GEORGE L. McLEOD, Lumberton, N. C.
Duplin County—Z. J. CARTER, Wallace, N. C.
Sampson County—JOHN J. FOWLER, Clinton, N. C.
Martin County—HARRY STUBBS, Williamston, N. C.
Cumberland County—H. B. DOWNING, Cedar Creek, N. C.
Lincoln County—R. M. ROSEMAN, Lincolnton, N. C.
Pitt County—H. W. WHEDBEE, Greenville, N. C.
Tyrrell County—JOHN PINNER, East Lake, N. C.
Northampton County—GARLAND E. MIDGETT, Jackson, N. C.
Washington County—A. G. WALKER, Washington, N. C.
Wilson County—ED. WOODARD, Wilson, N. C.
Edgecombe County—H. A. GILLIAM, Tarboro, N. C.
Halifax County—PAUL KITCHIN, Scotland Neck, N. C.
Perquimans County—R. A. BRINN, Hertford, N. C.
Warren County—HUSKELL POLK, Warrenton, N. C.

Upon motion made and seconded this report was unanimously adopted.

Mr. Brown was officially notified of his election to the presidency of the Association and in response said that he appreciated the honor the convention had bestowed upon him, and promised his earnest efforts to accomplish everything he could for drainage in North Carolina. He stated that he believed the ultimate result of this drainage work would be increased productiveness of the farms, and therefore increased income to the producers, and that by making our low swamp lands more productive and more attractive we would cause our young men to become more attached to our farms and more willing to remain on the farms. Each year will see more and more land brought under cultivation, and as we put farming more and more on a business basis, we will very soon see our young men going into farming as a profession, and our farm lands will be settled by North Carolinians instead of immigrants from other countries.

Mr. W. C. Riddick, Professor of Civil Engineering of the Agricultural and Mechanical College, was then called upon, and he made a very pleasing address, showing the relation of the college to the agricultural and engineering interests of the State. He stated that he represented President D. H. Hill, who was unable to be present, and he promised the support of the Agricultural and Mechanical College to any who would ask them for assistance or advice in this work. He stated that the college was training young men for this work, teaching them the principles of drainage engineering. He also stated that since the passage of the North Carolina Drainage Law, which now makes it possible to

form drainage districts, that the college was preparing courses that would train the young men especially for this particular work in North Carolina.

By unanimous vote of the delegates the officers and crew of the revenue cutter "Pamlico" were thanked for their courtesies extended to the delegates on board, and all expressed themselves greatly pleased with the trip down the river.

A resolution was adopted making the annual dues of the North Carolina Drainage Association \$1.

AFTERNOON SESSION, NOVEMBER 12.

The afternoon session was called to order at 2 P. M. with the newly elected president, Joseph A. Brown, in the chair.

Congressman Charles R. Thomas, of New Bern, was the first speaker, and in a very able address pledged his support to the drainage work in North Carolina, promising to use his influence towards the furtherance of this cause. He expressed himself as very much pleased at the work done since the last convention.

The chairman then called upon Mr. Ernest M. Green, chairman, for the report of the Committee on Resolutions, who reported as follows:

REPORT OF COMMITTEE ON RESOLUTIONS.

Whereas, the reclamation of our swamp and overflowed lands by drainage and the drainage of our wet land now under cultivation which have been insufficiently drained constitute one of the most important problems confronting the people of North Carolina and the country at large. There are in this State about 2,800,000 acres of unreclaimed swamp land which has heretofore been regarded as having no value except for the timber thereon, and in many instances the timber is of little value because of the amount of water upon the land and the consequent expense of removing the same. It is now known by recent investigation that at least 1,000,000 acres of this land may be drained and reclaimed and subjected to cultivation, and that it comprises as fertile soil as exists in any section of the country.

And *whereas*, one of the obstacles to successful farming is the insufficient drainage of lands which have been for many years under cultivation. The production of crops upon such lands is so uncertain and hazardous as seriously to diminish profits and impair the value of such lands. This insufficiently drained land, at the lowest estimate, comprises an area of more than double the unreclaimed lands, representing an annual loss and drain upon the State's resources aggregating a very large sum. There is scarcely a county in the whole State of North Carolina which does not contain areas of imperfectly drained land.

And *whereas*, in many cases, as stated, this character of land has been under cultivation for many generations, and it may be well to inquire why they have been permitted to remain undrained, thereby diminishing their productive ca-

capacity and impairing their value. There is a reason for this which may probably be expressed in the statement that individual landowners could not alone effectively drain their lands, but that co-operation was necessary in the formation of drainage districts, and that no legal machinery had been provided for this co-operative method.

And *whereas*, the object of this Drainage Association is to promote in every possible way the movement which shall result in the drainage of lands, either unreclaimed or heretofore reclaimed, we emphasize the statement that the work of this Association is confined to no particular section, but embraces the entire State. We further wish to emphasize the statement that efficient drainage is at the base of successful farming. A most important movement is now in progress seeking to inculcate better farm methods and more intelligent knowledge of the soil and plant life. Every other requisite in successful farming may be applied, the individual farmer may be trained and skilled as he ought to be, and yet he cannot produce crops unless his lands are well drained: Therefore,

Resolved, That we thank the General Assembly of 1909 for enacting a modern drainage law in form substantially as recommended at the last session of this Drainage Association. We believe that this law contains the essential procedure whereby lands may be drained in large areas upon the co-operative plan and upon an economical basis.

Resolved, That we urge the General Assembly at its next session to enact a law authorizing the State Geological and Economic Survey to employ a competent drainage engineer, under the supervision of the State Geologist, who may be employed in visiting sections where drainage is necessary and confer with the landowners and make preliminary investigations and giving assistance in other respects to this work, and that necessary appropriation be made to the Geological Survey for salary and expenses of said engineer. We also urge that body to make the necessary appropriation whereby the compensation of the drainage engineer appointed in drainage proceedings may be advanced and paid preliminarily by the State Geological and Economic Survey as heretofore authorized by existing law. We regard both of these provisions as very necessary for the best administration of the law.

Resolved, That we also urge the General Assembly to support by liberal appropriations the State Geological and Economic Survey and all other departments of the State Government which have been created for the purpose of promoting agriculture and industrial development of the State in all lines of endeavor. With liberal appropriations and with trained, efficient public servants to administer the law and expend the money, a strong impetus will be given and greater progress made in the development of our resources.

Resolved, That we urge upon the members of this Association and its officers and upon the progressive citizens everywhere the importance of aiding in this educational movement for the drainage of our lands. Agitation and education by the holding of meetings in our rural sections will gradually create such intelligent sentiment and knowledge as will result in the drainage of all our lands, and consequently in greatly augmenting the prosperity and wealth of our people. We urge upon our efficient State Geologist that within the limitations imposed upon him that he render every possible aid in affording instruction to the people upon this subject.

Resolved, That we express our gratitude to the United States Department of Agriculture, under the able administration of Secretary James Wilson, for the substantial aid which has been rendered by that department in co-operating with the State of North Carolina. In this connection we have peculiar pleasure in mentioning the name of C. G. Elliott, Chief of the Bureau of Drainage Investigations in that department, who has at all times evinced an interest in the drainage of our lands and through whom have been made many preliminary investigations and actual detailed surveys and estimates of costs by the trained corps of engineers in his bureau. Without the aid of that bureau much less progress would have been made in the formation of drainage districts. In this connection we cannot refrain from expressing our appreciation of the work done by Mr. J. O. Wright, Supervising Drainage Engineer of the Bureau of Drainage Investigations. He is not only a trained engineer and has not only performed his official duty, but he has exhibited a degree of zeal and personal interest in our people and in the promotion of this movement which arouses our warmest commendation and gratitude. Our thanks are also extended to Mr. L. W. Page, Chief of the Office of Public Roads of the United States Department of Agriculture, for detaching Mr. M. O. Eldridge to attend this convention, who has delivered a most interesting lecture upon the important relation between drainage and public roads. We also thank Mr. Gifford Pinchot, Chief Forester of the United States Department of Agriculture, for detaching Mr. Bristow Adams to that service, who has delivered a most instructive lecture upon the relation of forestry and other resources to drainage.

Resolved, That we extend thanks to the Secretary of the Treasury and to Capt. Worth G. Ross, Chief of the Revenue Cutter Service, for the courtesy extended in placing the revenue cutter "Pamlico" at the disposition of the delegates to this convention for a most delightful trip down Neuse River. To Hon. Charles R. Thomas we are indebted for his intervention in this behalf, and also to the officers and crew of the steamer, for their kind consideration and courtesies.

Resolved, That we extend thanks to the Board of Commissioners of Craven County for the use of the courthouse for this convention. We wish especially to thank the honorable Mayor and Board of Aldermen and the Chamber of Commerce for the delightful reception to the delegates tendered in the beautiful hall in the Elks Building, which structure would be creditable to a city much larger than the city of New Bern. And to the citizens of New Bern generally we extend thanks for their numerous and thoughtful courtesies. To the officers of this Association for the past year, who have given loyal and valuable service to the same, we wish to make acknowledgment and tender our thanks.

Resolved, That we thank the press of the State for the publicity and educational work which they have contributed to the cause. The continued success of this movement depends in a large degree upon the extent to which the members of the press shall aid. Publicity and education are two prime essentials upon which the success of this economic movement depend, and no other factor can contribute more in this respect than the press of the State.

Finally, we congratulate the people of the State upon the progress which has been made since the passage of the general drainage law in March of the present year. At least twelve proceedings have been instituted with a view of organizing drainage districts under that law, and landowners in many other

sections are agitating the subject with a view of organizing other districts. We confidently predict that before the next meeting of this Association we will be able to report that a gratifying number of districts have been actually formed, the bonds sold, contracts consummated and the work of construction under way and completed, thereby affording object-lessons for the encouragement of other sections.

E. M. GREEN, *Chairman*.

The report of this committee was accepted and unanimously adopted.

DISCUSSION OF NORTH CAROLINA DRAINAGE LAW.

The convention then took up the discussion of the North Carolina Drainage Law. This discussion was led by Mr. Ernest M. Green, who introduced the bill into the House during the Legislature of 1909 and worked so vigorously for its passage. He stated at the outset that he had not heard of any adverse criticism regarding the law, except that relating to the payment of the engineers for the preliminary survey. The act authorized the State Geologist to pay for this preliminary work, but without making any appropriation to provide him with funds for the purpose. This made it necessary for the petitioners for the drainage district to advance the money for this preliminary work, or for the drainage engineer himself to advance this money, the bond filed by the petitioners being security for reimbursement.

The different sections of the law were taken up and discussed, the following delegates entering into the discussion: Charles R. Thomas, Patrick Matthew, C. R. Humphries, B. F. Keith, Joseph Hyde Pratt, Joseph A. Brown, and Lawrence Brett.

At the close of this discussion the chairman made a short address to the delegates regarding the future work of the Association, urging all the delegates to carry on the work in their own counties. He stated that the Association was interested not only in the drainage of swamp and overflowed lands, but also in the drainage of high lands and tile drainage of all farm lands where such drainage was needed. He stated that if we could have charts and maps prepared showing exact plans of drainage, and have these hung in the schoolhouses of North Carolina, he thought considerable good could be done towards educating the people as to how to drain their land. He stated further that considerable education was needed regarding bond issues and the value of drainage, and that he, for one, was willing to make addresses on these subjects whenever called upon, and that he hoped all the delegates would also be ready to respond, whenever possible, to do this same kind of educational work.

At the close of Mr. Brown's address the convention adjourned *sine die*.

COUNTIES REPRESENTED AT CONVENTION.

The following counties were represented at the convention: Beaufort, Bladen, Carteret, Chowan, Columbus, Craven, Currituck, Duplin, Guilford, Hertford, Hyde, Jones, New Hanover, Orange, Pamlico, Pasquotank, Pender, Pitt, Robeson, Wake, Washington and Wilson.

NORTH CAROLINA DRAINAGE LAW.

[CHAPTER 442, LAWS OF 1909.]

AN ACT TO PROMOTE THE PUBLIC HEALTH, CONVENIENCE AND WELFARE BY LEVEEING, DITCHING AND DRAINING THE WET, SWAMP AND OVERFLOWED LANDS OF THE STATE, AND PROVIDING FOR THE ESTABLISHMENT OF LEVEE OR DRAINAGE DISTRICTS FOR THE PURPOSE OF ENLARGING OR CHANGING ANY NATURAL WATER COURSES, AND FOR DIGGING DITCHES OR CANALS FOR SECURING BETTER DRAINAGE OR PROVIDING BETTER OUTLETS FOR DRAINAGE, FOR BUILDING LEVEES OR EMBANKMENTS AND INSTALLING TIDE GATES OR PUMPING PLANTS FOR THE RECLAMATION OF OVERFLOWED LANDS, AND PRESCRIBING A METHOD FOR SO DOING; AND PROVIDING FOR THE ASSESSMENT AND COLLECTION OF THE COST AND EXPENSE OF THE SAME, AND ISSUING AND SELLING BONDS THEREFOR, AND FOR THE CARE AND MAINTENANCE OF SUCH IMPROVEMENTS, WHEN CONSTRUCTED.

The General Assembly of North Carolina do enact:

SECTION 1. *Duty and powers of the court.*

The clerk of the Superior Court of any county in the State of North Carolina shall have jurisdiction, power and authority to establish a levee or drainage district or districts in his county, and to locate and establish levees, drains or canals, and cause to be constructed, straightened, widened or deepened any ditch, drain or water course, and to build levees or embankments and erect tide gates and pumping plants for the purpose of draining and reclaiming wet, swamp or overflowed lands; and it is hereby declared that the drainage of swamps and the drainage of the surface water from agricultural lands and the reclamation of tidal marshes shall be considered a public benefit and conducive to the public health, convenience, utility and welfare.

Jurisdiction of clerk of superior court.
Levee or drainage districts.

Drainage a public benefit.

SEC. 2. *Petition—Bond—Board of viewers.*

Whenever a petition signed by a majority of the resident land-owners in a proposed drainage district or by the owners of three-fifths of all the land which will be affected by or assessed for the expense of the proposed improvements shall be filed in the office of the clerk of the Superior Court of any county in which a part of said lands are located, setting forth that any specific body or district of land in the county and adjoining counties, described in such a way as to convey an intelligent idea as to the location of such land, is subject to overflow or too wet for cultivation, and the public benefit or utility or the public health, convenience or welfare will be promoted by draining, ditching or leveeing the same or by changing or improving the natural water courses, and setting forth therein, as far as practicable, the starting point, route and

Petition for establishment of drainage district.

terminus and lateral branches, if necessary, of the proposed improvement, and there is filed therewith a bond for the amount of fifty dollars per mile for each mile of the ditch or proposed improvement, signed by two or more sureties or by some lawful and authorized surety company, to be approved by the clerk of the Superior Court and conditioned for payment of all costs and expenses incurred in the proceedings in case the court does not grant the prayer of said petition, the said clerk shall issue a summons to be served on all the defendant landowners who have not joined in the petition and whose lands are included in the proposed drainage district. Upon the return day the said clerk shall appoint a disinterested and competent civil and drainage engineer and two resident freeholders of the county or counties in which said lands are located as a board of viewers to examine the lands described in the petition and make a preliminary report thereon. Such drainage engineer shall be appointed upon the recommendation of the State Geologist, and the compensation for the services of such engineer and his necessary assistants, to be fixed as herein provided, shall be paid by the State Geological and Economic Survey, said sum or sums so paid to be refunded when the drainage fund is subsequently provided by the sale of bonds or otherwise. When the lands proposed to be drained and created into a drainage district are located in two or more counties the clerk of the Superior Court of either county shall have and exercise the jurisdiction herein conferred, and the venue shall be in that county in which the petition is first filed. The law and rules regulating special proceedings shall be applicable to this act, so far as may be practicable. The summons may be served by publication as to any defendants who cannot be personally served as provided by law.

Bond for cost of proceedings.

Summons to be served on landowners.

Appointment of board of viewers.

Appointment and payment of drainage engineer.

Jurisdiction when land is in more than one county.

Rules of proceeding.

Summons served by publication.

SEC. 3. *Examination—Preliminary report.*

Board of viewers to examine lands and route.

Surveys.

Report to set forth:
 If drainage is practicable;
 If drainage will benefit public health or any public highway or conduce to general welfare.
 If drainage will benefit the specific lands;
 If all lands to be benefited are included.

The board of viewers shall proceed to examine the land described in said petition, and other land if necessary to locate properly such improvement or improvements as are petitioned for, along the route described in the petition, or any other route answering the same purpose if found more practicable or feasible, and may make surveys such as may be necessary to determine the boundaries and elevation of the several parts of the district, and shall make and return to the clerk of the Superior Court within thirty days, unless the time shall be extended by the court, a written report, which shall set forth:

1. Whether the proposed drainage is practicable or not.
2. Whether it will benefit the public health or any public highway or be conducive to the general welfare of the community.
3. Whether the improvement proposed will benefit the lands sought to be benefited.
4. Whether or not all the lands that are benefited are included in the proposed drainage district.

They shall also file with this report a map of the proposed Map to be filed. drainage district, showing the location of the ditch or ditches or other improvement to be constructed and the lands that will be affected thereby, and such other information as they may have collected that will tend to show the correctness of their findings. Other information.

SEC. 4. *Filing preliminary report.*

The clerk of the Superior Court shall consider this report. If the viewers report that the drainage is not practicable or that it will not benefit the public health or any public highway or be conducive to the general welfare of the community, and the court shall approve such findings, the petition shall be dismissed at the cost of the petitioners. Such petition or proceeding may again be instituted by the same or additional landowners at any time after six months, upon proper allegations that conditions have changed or that material facts were omitted or overlooked. If the viewers report that the drainage is practicable and that it will benefit the public health or any public highway or be conducive to the general welfare of the community, and the court shall so find, then the court shall fix a day when the report will be further heard and considered. Clerk to consider report. Petition dismissed if work not reported practicable and beneficial. Petition renewed after six months. Day for further hearing if report be favorable.

SEC. 5. *Notice.*

If the petition is entertained by the court, notice shall be given by publication for two consecutive weeks in some newspaper of general circulation within the county or counties, if one shall be published in such counties, and also by posting a written or printed notice at the door of the courthouse and at five conspicuous places within the drainage district that on the date set, naming the day, the court will consider and pass upon the report of the viewers. At least fifteen days shall intervene between the date of the publication and the posting of the notices and the date set for the hearing. Notice of hearing. Time of notice.

SEC. 6. *Hearing preliminary report.*

At the date appointed for the hearing the court shall hear and determine any objections that may be offered to the report of the viewers. If it appear that there is any land within the proposed levee or drainage district that will not be affected by the leveeing or drainage thereof, such lands shall be excluded and the names of the owners withdrawn from such proceeding; and if it shall be shown that there is any land not within the proposed district that will be affected by the construction of the proposed levee or drain, the boundary of the district shall be so changed as to include such land, and such additional landowners shall be made parties plaintiff or defendant, respectively, and summons shall issue accordingly, as hereinbefore provided. After such change in the boundary is made, the sufficiency of the petition shall be verified, to determine whether or not it conforms to the requirements of the statute as provided in section two. The efficiency of the drainage or levees may also be determined, and if it appears that Court to hear and determine objections. Amendments to petition and changes in boundary and location.

the location of any levee or drain can be changed so as to make it more effective, or that other branches or spurs should be constructed, or that any branch or spur projected may be eliminated or other changes made that will tend to increase the benefits of the proposed work, such modification and changes shall be made by the board. The engineer and the other two viewers may attend this meeting and give any information or evidence that may be sought to verify and substantiate their report. If necessary, the petition, as amended, shall be referred by the court to the engineer and two viewers for further report. The above facts having been determined to the satisfaction of the court, and the boundaries of the proposed district so determined, it shall declare the establishment of the drainage or levee district, which shall be designated by a name or number, for the object and purpose as herein set forth.

Board of viewers may attend hearing.

Reference of petition for further report.

Establishment of district.

Name or number.

SEC. 7. *May condemn land.*

Power to condemn land.

If it shall be necessary to acquire a right of way or an outlet over and through lands not affected by the drainage, and the same cannot be acquired by purchase, then and in such event the power of eminent domain is hereby conferred, and the same may be condemned. Such owner or owners of the land proposed to be condemned may be made parties defendant in the manner of an ancillary proceeding, and the procedure shall be substantially as provided for the condemnation of rights of way for railroads in chapter sixty-one of the Revisal of one thousand nine hundred and five, so far as the same may be applicable, and such damages as may be awarded as compensation shall be paid by the board of drainage commissioners out of the first funds which shall be available from the proceeds of sale of bonds or otherwise.

Procedure for condemnation.

Payment of damages.

SEC. 8. *Right of appeal.*

Appeal to superior court.

Any person or corporation owning lands within the drainage or levee district which he or it thinks will not be benefited by the improvement and should not be included in the district may appeal from the decision of the court to the Superior Court of such county, in term time, by filing an appeal, accompanied by a bond conditioned for the payment of the costs, if the appeal should be decided against him, for such sum as the court may require, not exceeding two hundred dollars, signed by two or more solvent sureties, or in some approved surety company, to be approved by the court.

Bond on appeal.

SEC. 9. *Complete survey.*

Report referred for complete survey.

After the district is established the court shall refer the report of the engineer and viewers back to them to make a complete survey, plans and specifications for the drains or levees or other improvements, and fix a time when said engineer and viewers shall complete and file their report, not exceeding sixty days.

Complete report within sixty days.

SEC. 10. *Complete report.*

The engineer and viewers shall have power to employ such assistants as may be necessary to make a complete survey of the drainage district, and shall enter upon the ground and make a survey of the main drain or drains and all its lateral. The line of each ditch, drain or levee shall be plainly and substantially marked on the ground. The course and distance of each ditch shall be carefully noted and sufficient notes made, so that it may be accurately plotted and mapped. A line of levels shall be run for the entire work and sufficient data secured from which accurate profiles and plans may be made. Frequent bench marks shall be established along the line, on permanent objects, and their elevation recorded in the field books. If it is deemed expedient by the engineer and viewers, other levels may be run to determine the fall from one part of the district to another. If an old water course, ditch or channel is being widened, deepened or straightened, it shall be accurately cross-sectioned, so as to compute the amount of cubic yards saved by the use of such old channel. A drainage map of the district shall then be completed, showing the location of the ditch or ditches and other improvements and the boundary, as closely as may be determined by the records of the lands owned by each individual landowner within the district. The location of any railroads or public highways and the boundary of any incorporated towns or villages within the district shall be shown on the map. There shall also be prepared to accompany this map a profile of each levee, drain or water course, showing the surface of the ground, the bottom or grade of the proposed improvement and the number of cubic yards of excavation or fill in each mile or fraction thereof, and the total yards in the proposed improvement and the estimated cost thereof, and plans and specifications, and the cost of any other work required to be done.

Board of viewers
may employ
assistants.

Survey of main
drain and
laterals.
Detailed instructions for making
survey.

Drainage map to
be drawn.
Details of map.

Profile to
accompany map.

Estimate of cost.
Plans, specifications
and cost of
other work.

SEC. 11. *Assessment of damages.*

It shall be the further duty of the engineer and viewers to assess the damages claimed by anyone that is justly right and due to them for land taken or for inconvenience imposed because of the construction of the improvement, or for any other legal damages sustained. Such damage shall be considered separate and apart from any benefit the land would receive because of the proposed work, and shall be paid by the board of drainage commissioners when funds shall come into their hands.

Board of viewers
to assess claims
for damages.

Benefits not
considered.

Payment of
damages.

SEC. 12. *Classification of land according to benefits.*

It shall be the further duty of the engineer and viewers to personally examine the land in the district and classify it with reference to the benefit it will receive from the construction of the levee, ditch, drain or water course or other improvement. In the case of drainage, the degree of wetness of the land, its proximity to the ditch or a natural outlet and the fertility of the

Board of viewers
to examine and
classify lands.

Considerations in
determining
benefit.

soil shall be considered in determining the amount of benefit it will receive by the construction of the ditch. The land benefited shall be separated in five classes. The land receiving the highest benefit shall be marked "Class A"; that receiving the next highest benefit, "Class B"; that receiving the next highest benefit, "Class C"; that receiving the next highest benefit, "Class D," and that receiving the smallest benefit, "Class E." The holdings of any one landowner need not necessarily be all in one class, but the number of acres in each class shall be ascertained, though its boundary need not be marked on the ground or shown on the map. The total number of acres owned by one person in each class and the total number of acres benefited shall be determined. The total number of acres of each class in the entire district shall be obtained and presented in tabulated form. The scale of assessment upon the several classes of land returned by the engineer and viewers shall be in the ratio of five, four, three, two and one; that is to say, as often as five mills per acre is assessed against the land in "Class A," four mills per acre shall be assessed against the land in "Class B," three mills per acre in "Class C," two mills per acre in "Class D," and one mill per acre in "Class E." This shall form the basis of the assessment of benefits to the lands for drainage purposes.

Land in five classes, "A," "B," "C," "D," and "E."

Number of acres in each class ascertained.

Total acreage.

Scale of assessment.

SEC. 13. *Cost of the survey.*

Account kept and reported to court.

The engineer and viewers shall keep an accurate account and report to the court the name and number of days each person was employed on the survey and the kind of work he was doing and any expenses that may have been incurred in going to and from the work, and the cost of any supplies or material that may have been used in making the survey.

SEC. 14. *Delay—Extension of time.*

Court may extend time for cause shown.

In case the work is delayed by high water, sickness or any other good cause, and the report is not completed at the time fixed by the court, the engineer and viewers shall appear before the court and state in writing the cause of such failure and ask for sufficient time in which to complete the work, and the court shall set another date by which the report shall be completed and filed.

SEC. 15. *Final report—Notice of hearing.*

Examination of final report.

When the final report is completed and filed it shall be examined by the court, and if it is found to be in due form and in accordance with the law it shall be accepted, and if not in due form it may be referred back to the engineer and viewers, with instructions to secure further information, to be reported at a subsequent date to be fixed by the court. When the report is fully completed and accepted by the court a date not less than twenty days thereafter shall be fixed by the court for the final hearing upon the report, and notice thereof shall be given by publication in a news-

Time for final hearing.

Notice of final hearing.

paper of general circulation in the county and by posting a written or printed notice on the door of the courthouse and at five conspicuous places throughout the district, such publication to be made for at least two weeks before the final hearing. During this time a copy of the report shall be on file in the office of the clerk of the Superior Court and shall be open to the inspection of any landowner or other person interested within the district.

Time of
publication.
Report open to
inspection.

SEC. 16. *Adjudication—Final report.*

At the date set for hearing any landowner may appear in person or by counsel and file his objection in writing to the report of the viewers; and it shall be the duty of the court to carefully review the report of the viewers and the objections filed thereto, and make such changes as are necessary to render substantial and equal justice to all the landowners in the district. If, in the opinion of the court, the cost of construction, together with the amount of damages assessed, is not greater than the benefits that will accrue to the land affected, the court shall confirm the report of the viewers. If, however, the court finds that the cost of construction, together with the damages assessed, is greater than the resulting benefit that will accrue to the lands affected, the court shall dismiss the proceedings at the cost of the petitioners, and the sureties upon the bond so filed by them shall be liable for such costs: *Provided*, that the State Geological and Economic Survey may remit and release to the petitioners the costs expended by said board on account of the engineer and his assistants. The court may from time to time collect from the petitioners such amounts as may be necessary to pay costs accruing, other than costs of the engineer and his assistants, such amounts to be repaid from the special tax hereby authorized.

Landowners may
appear in person
or by counsel.
Objections in
writing.
Court to review
report and
objections.

Confirmation of
report.

Dismissal of
proceedings.

Proviso: release
of costs of
engineer and
assistants.

Payments on
costs.

SEC. 17. *Appeal.*

Any party aggrieved may, within ten days after the confirmation of the assessor's report, appeal to the Superior Court in term time. Such appeal shall be taken and prosecuted as now provided in special proceedings.

Appeal to
superior court.

SEC. 18. *Drainage record.*

The clerk of the Superior Court shall provide a suitable book, to be known as the "drainage record," in which he shall transcribe every petition, motion, order, report, judgment or finding of the board in every drainage transaction that may come before it, in such a manner as to make a complete and continuous record of the case. Copies of all the maps and profiles are to be furnished by the engineer and marked by the clerk "official copies," which shall be kept on file by him in his office, and one other copy shall be pasted or otherwise attached to his record book.

Drainage record.

Copies of maps
and profiles kept
on file.
Copy attached to
record book.

SEC. 19. After the said drainage district shall have been declared established, as aforesaid, and the survey and plan therefor approved, the court shall appoint three persons, who shall be desig-

Board of drainage
commissioners.

Election by landowners.	• nated as the board of drainage commissioners. Such drainage commissioners shall first be elected by the owners of land within the drainage or levee district, or by a majority of same, in such manner as the court shall prescribe. The court shall appoint those receiving a majority of the votes. If any one or more of such proposed commissioners shall not receive the vote of a majority of such landowners the court shall appoint all or the remainder from among those voted for in the election. Any vacancy thereafter occurring shall be filled in like manner. Such three drainage commissioners, when so appointed, shall be immediately created a body corporate under the name and style of "The Board of Drainage Commissioners of .....District,"
Appointment by court.	
Vacancies.	
Drainage commissioners incorporated.	
Corporate name.	
Corporate powers.	with the right to hold property and convey the same, to sue and be sued, and shall possess such other powers as usually pertain to corporations. They shall organize by electing from among their number a chairman and a vice chairman. They shall also elect a secretary, either within or without their body. The treasurer of the county in which the proceeding was instituted shall be <i>ex officio</i> treasurer of such drainage commissioners. Such board of drainage commissioners shall adopt a seal, which they may alter at pleasure. The board of drainage commissioners shall have and possess such powers as are herein granted. The name of such drainage district, whether designated by number or otherwise, shall constitute a part of its corporate name; for illustration, "The Board of Drainage Commissioners of (No. 1 or Moyock) District."
Organization.	
Treasurer.	
Seal.	

SEC. 20. *Superintendent of construction.*

Superintendent of construction.	The board of drainage commissioners shall appoint a competent person as superintendent of construction. Such person shall furnish a bond, to be approved by the commissioners, in the penal sum of ten thousand dollars, conditioned upon the honest and faithful performance of his duties, such bond to be in favor of the board of drainage commissioners.
Bond of superintendent.	

SEC. 21. *Notice of letting contract—Bond.*

Advertisement for letting of contracts.	The board of drainage commissioners shall cause notice to be given for two consecutive weeks in some newspaper published in the county wherein such improvement is located, if such there be, and such additional publication elsewhere as they may deem expedient, of the time and place of letting the work of construction of said improvement, and in such notice they shall specify the approximate amount of work to be done and the time fixed for the completion thereof; and in the date appointed for the letting, they, together with the superintendent of construction, shall convene and let to the lowest responsible bidder, either as a whole or in sections, as they may deem most advantageous for the district, the proposed work. No bid shall be entertained that exceeds the estimated cost, except for good and satisfactory reasons it shall be shown that the original estimate was erroneous. They shall have the right to reject all bids and advertise again the work, if in
Work let to lowest bidder.	
Bids exceeding estimate not considered.	
Right to reject all bids.	

their judgment the interest of the district will be subserved by doing so. The successful bidder shall be required to enter into a contract with the board of drainage commissioners and to execute a bond for the faithful performance of such contract, with sufficient sureties, in favor of the board of drainage commissioners for the use and benefit of the levee or drainage district, in an amount equal to twenty-five per centum of the estimated cost of the work awarded to him.

Successful bidder to enter into contract and give bond.

SEC. 22. *Payment for work done.*

The superintendent in charge of construction shall make monthly estimates of the amount of work done, and furnish one copy to the contractor and file the other with the secretary of the board of drainage commissioners against such contractor and his bond five days after the filing of such estimate, meet and direct the secretary to draw a warrant in favor of such contractor for ninety per centum of the work done, according to the specifications and contract; and upon the presentation of such warrant, properly signed by the chairman and secretary, to the treasurer of the drainage fund, he shall pay the amount due thereon. When the work is fully completed and accepted by the superintendent he shall make an estimate for the whole amount due, including the amounts withheld on the previous monthly estimates, which shall be paid from the drainage fund as before provided.

Superintendent to make and file monthly estimates. Warrants for payments.

Payment of warrants.

Payment in full on completion of work.

SEC. 23. *Failure of contractor—Reletting.*

If any contractor to whom a portion of said work shall have been let shall fail to perform the same according to the terms specified in his contract, action may be had in behalf of the board of drainage commissioners against such contractor and his bond in the Superior Court for damages sustained by the levee or drainage district, and recovery made against such contractor and his sureties. In such an event the work shall be advertised and relet in the same manner as the original letting.

Suit on bond of contractor.

Work advertised and relet.

SEC. 24. *Right of contractor.*

In the construction of the work the contractor shall have the right to enter upon the lands necessary for this purpose and the right to remove private or public bridges or fences and to cross private lands in going to or from the work. In case the right of way of the improvement is through timber the owner thereof shall have the right to remove it, if he so desires, before the work of construction begins, and in case it is not removed by the landowner it shall become the property of the contractor and may be removed by him.

Right of contractor to enter on lands.

Removal and ownership of timber.

SEC. 25. *Highways affected.*

Where any public ditch, drain or water course established under the provisions of this act crosses a public highway the actual cost of constructing the same across the highway or removing old bridges or building new ones shall be paid for from the fund of

Cost of drains across highways.

Highways benefited to be included in report.

Notice of assessment on highways.

the drainage district. Wherever any highway within the levee or drainage district shall be beneficially affected by the construction of any improvement or improvements in such district it shall be the duty of the viewers appointed to classify the land to give in their report the amount of benefit to such highway, and notice shall be given by the clerk of the Superior Court to the clerk of the board of county commissioners in the county where the road is located of the amount of such assessment, and the county commissioners shall have the right to appear before the court and file its objections, the same as any landowner.

Sec. 26. *Railroad—Damage—Benefit.*

Procedure to determine place and manner of crossing right of way of railroad companies.

Agreement.

Procedure in case of disagreement.

Facts not considered as damages.

Benefits to be assessed.

Assessment at a fixed sum.

Whenever the engineer and the viewers in charge shall make a survey for the purpose of locating a public levee or drainage district or changing a natural water course, and the same would cross the right of way of any railroad company, it shall be the duty of the owner in charge of the work to notify the railroad company, by serving written notice upon the agent of such company or its lessee or receiver, that they will meet the company at the place where the proposed ditch, drain or water course crosses the right of way of such company, said notice fixing the time of such meeting, which shall not be less than ten days after the service of the same, for the purpose of conferring with said railroad company with relation to the place where and the manner in which such improvement shall cross such right of way. When the time shall arrive fixed for such conference, unless for good cause more time is agreed upon, it shall be the duty of the viewers in charge and the railroad company to agree, if possible, upon the place where and the manner and method in which such improvement shall cross such right of way. If the viewers in charge and the railroad company cannot agree, or if the railroad company shall fail, neglect or refuse to confer with the viewers, they shall determine the place and manner of crossing the right of way of said railroad company, and shall specify the number and size of openings required, and the damages, if any, to said railroad company, and so specify in their report. The fact that the railroad company is required by the construction of the improvement to build a new bridge or culvert or to enlarge or strengthen an old one shall not be considered as damages to said railroad company. The engineer and viewers shall also assess the benefits that will accrue to the right of way, roadbed and other property of said company by affording better drainage or a better outlet for drainage, but no benefits shall be assessed because of the increase in business that may come to said road because of the construction of the improvement. The benefits shall be assessed at a fixed sum, determined solely by the physical benefit that its property will receive by the construction of said improvement, and it shall be reported by the viewers as a special assessment, due personally from the railroad company as a special assessment; it may be collected in the manner of an ordinary debt in any court having jurisdiction.

SEC. 27. *Notice to railroad.*

The clerk of the Superior Court shall have notice served upon the railroad company of the time and place of the meeting to hear and determine the final report of the engineer and viewers, and the said railroad company shall have the right to file objections to said report and to appeal from the findings of the board of commissioners in the same manner as any landowner. But such an appeal shall not delay or defeat the construction of the improvement.

Notice of final hearing to be served on railroad company.

SEC. 28. *Manner of crossing right of way—Penalty for delay—Cost.*

After the contract is let and the actual construction is commenced, if the work is being done with a floating dredge, the superintendent in charge of construction shall notify the railroad company of the probable time at which the contractor will be ready to enter upon the right of way of said road and construct the work thereon. It shall be the duty of said railroad to send a representative to view the ground with the superintendent of construction and arrange the exact time at which such work can be most conveniently done. At the time agreed upon the said railroad company shall remove its rails, ties, stringers and such other obstructions as may be necessary to permit the dredge to excavate the channel across its right of way. The work shall be so planned and conducted as to interfere in the least possible manner with the business of said railroad. In case the railroad company refuses and fails to remove its track and allow the dredge to construct the work on its right of way it shall be held as delaying the construction of the improvement, and such company shall be liable to a penalty of twenty-five dollars per day for each day of delay, to be collected by the board of drainage commissioners for the benefit of the drainage district as in the case of other penalties. Such a fine may be collected in any court having jurisdiction and shall inure to the benefit of the drainage district. Within thirty days after the work is completed, an itemized bill for the actual expenses incurred by the railroad company for opening its tracks shall be made and presented to the superintendent of construction of the drainage improvement. Such bill, however, shall not include the cost of putting in a new bridge or strengthening or enlarging an old one. The superintendent of construction shall audit this bill and, if found correct, approve the same and file it with the secretary of the board of drainage commissioners. The commissioners shall deduct from this bill the cost of the excavation done by the dredge on the right of way of said railroad company at the contract price, and pay the difference, if any, to said railroad company.

Notice to railroad company of time of work.

Time to be agreed on.

Railroad company to remove obstructions.

Refusal to remove obstructions and permit work a delay of construction. Penalty.

Railroad company to present itemized bill.

Superintendent to audit bill.

Cost of excavation deducted and bill paid.

SEC. 29. *Control and repairs.*

Whenever any improvement constructed under this act is completed it shall be under the control and supervision of the board of drainage commissioners. It shall be the duty of the said

Completed work to be under control of drainage commissioners. Duty to maintain work.

board to keep the levee, ditch, drain or water course in good repair, and for this purpose they may levy an assessment on the lands benefited by the construction of such improvement in the same manner and in the same proportion as the original assessments were made, and the fund that is collected shall be used for repairing and maintaining the ditch, drain or water course in perfect order: *Provided, however*, that if any repairs are made necessary by the act or negligence of the owner of any land through which such improvement is constructed or by the act or negligence of his agent or employee, or if the same is caused by the cattle, hogs or other stock of said owner, employee or agent, then the cost thereof shall be assessed and levied against the lands of said owner alone, to be collected by proper suit instituted by the drainage commissioners. It shall be unlawful for any person to injure or damage or obstruct or build any bridge, fence or flood gate in such a way as to injure or damage any levee, ditch, drain or water course constructed or improved under the provisions of this act, and any person causing such injury shall be guilty of a misdemeanor, and upon conviction thereof may be fined in any sum not exceeding twice the damage or injury done or caused.

Assessment for maintenance and repairs.

Proviso: repairs made necessary by negligence.

Injury to works a misdemeanor.

Punishment.

SEC. 30. *Outlet for lateral drains.*

The owner of any land that has been assessed for the cost of the construction of any ditch, drain or water course, as herein provided, shall have the right to use the ditch, drain or water course as an outlet for lateral drains from said land; and if said land is separated from the ditch, drain or water course by the land of another or others, and the owner thereof shall be unable to agree with said other or others as to the terms and conditions on which he may enter their lands and construct said drain or ditch, he may file his ancillary petition in such pending proceeding to the court, and the procedure shall be as now provided by law. When the ditch is constructed it shall become a part of the drainage system and shall be under the control of the board of drainage commissioners and be kept in repair by them as herein provided.

Rights of owners of assessed lands.

Procedure for condemnation of access to drain.

SEC. 31. *Assessment-tax roll.*

After the classification of the land and the ratio of assessment of the different classes to be made thereon has been confirmed by the court, the drainage commissioners shall prepare an assessment roll or drainage-tax duplicate, giving a description of all the land in said drainage district, the name of the owner, so far as can be ascertained from the public records, and the amount of assessment against each of the several tracts of land. In preparing this assessment roll the board shall ascertain the total cost of the improvement, including the damages awarded and to be paid to the owners of land, and all incidental expenses, and deduct therefrom any special assessment made against any railroad or highway, and the remainder shall be the amount to be borne and paid by the lands benefited. This amount shall be assessed against the several

Drainage commissioners to prepare assessment-tax roll.

Ascertainment of amount to be assessed.

Assessment proportioned to benefits.

tracts of land according to the benefit received, as shown by the classification and ratio of assessment made by the viewers and confirmed by the board of drainage commissioners. This drainage-tax roll shall be made in duplicate, signed by the chairman and secretary, and one copy filed with the drainage record and the other delivered to the sheriff or other county tax collector. There shall be appended an order to collect the said assessments, and the same shall have the force and effect of a judgment as in the case of State and county taxes.

Drainage-tax roll in duplicate.

Order to collect assessment.

SEC. 32. *Time of payment.*

If the total cost of the work is less than an average of twenty-five cents per acre on all the land in the district the assessment made against the several tracts shall be collected in one installment, by the same officer and in the same manner as State and county taxes are collected, and payable at the same time. In case the total assessment exceeds the average of twenty-five cents per acre on all the lands in the district the said board of drainage commissioners may give notice of three weeks by publication in some newspaper of general circulation in the district, if there be one, and also by posting a written or printed notice at the door of the courthouse and at five conspicuous places in the drainage district, that they propose to issue bonds for the construction of said improvement, giving the amount of bonds to be issued, the rate of interest they are to bear and the time when payable. Any landowner having lands assessed in the district and not wanting to pay interest on the bonds may, within thirty days after the publication of said notice, pay the county treasurer the full amount of his assessment and have his land released therefrom.

Assessment payable in one installment.

Advertisement of purpose to issue drainage bonds.

Land released on payment of assessment.

SEC. 33. *Defense—Waiver.*

Each and every person owning land in the district which is assessed for the construction of an improvement who shall neglect or fail to pay the full amount of his assessment to the county treasurer within the time specified shall be deemed as consenting to the issuing of said drainage bonds, and in consideration of the right to pay his assessment in installments he hereby waives his right to any defense against the collection of said assessment because of any irregularity, illegality or defect in the proceedings prior to this time, except in the case of an appeal, as heretofore provided, which is not affected by this waiver. The term "person," as used in this act, includes any firm, company or corporation.

Landowner failing to pay assessment held as consenting to bond issue.

Right of defense waived.

SEC. 34. *Bond issue.*

At the expiration of the thirty days after the publication the board of drainage commissioners may issue bonds for the full amount of the assessment not paid in to the county treasurer, together with the interest thereon, costs of collection or other incidental expenses. These bonds shall bear six per cent interest per annum, payable annually, and shall be paid in ten equal annual installments. The first installment of the principal shall mature

Bond issue authorized. Amount.

Interest.

Maturity.

First installment.

Sale of bonds.	at the expiration of three years from the date of issue, and one installment each succeeding year for nine additional years. The commissioners may sell these bonds at not less than par and devote the proceeds to the payment of the work as it progresses.
Issue and record of bonds.	In no case shall bonds be issued until the tax levy has been made to meet them as they come due. The bonds issued shall be for the exclusive use of the levee or drainage district specified on their face, and should be numbered by the board of drainage commissioners and recorded in the drainage record, which record shall set out specifically the lands embraced in the district on which the tax has not been paid in full, and which land is assessed for the
Lien for assessment paramount.	payment of the bonds issued and the interest thereon. This assessment shall constitute the first and paramount lien, second only to State and county taxes, upon the lands assessed for the payment of said bonds and the interest thereon as they become due, and shall be collected in the same manner by the same officers as the
Collected as taxes. Mandamus for levy of assessments to meet installments of bonds.	State and county taxes are collected. If any installment of principal or interest represented by the said bond shall not be paid at the time and in the manner when the same shall become due and payable, and such default shall continue for a period of six months, the holder or holders of such bond or bonds upon which default has been made may have a right of action against said drainage district or the board of drainage commissioners of said district, wherein the court may issue a writ of <i>mandamus</i> against the said drainage district, its officers, including the tax collector and treasurer, directing the levying of a tax or special assessment as herein provided, and the collection of same, in such sum as may be necessary to meet any unpaid installments of principal and interest and cost of action; and such other remedies are hereby vested in the holder or holders of such bond or bonds in default as may be authorized by law; and the right of action is hereby vested in the holder or holders of such bond upon which default has been made authorizing them to institute suit against any officer on his official bond for failure to perform any duty imposed by the provisions of this act. The official bonds of the tax collector and county treasurer shall be liable for the faithful performance of the duties herein assigned them. Such bonds may be increased by the board of county commissioners.
Suits on official bonds.	

SEC. 35. *Relevy.*

Power to change or modify assessment.

Where the court has confirmed an assessment for the construction of any public levee, ditch or drain, and such assessment has been modified by the court of superior jurisdiction, but for some unforeseen cause it cannot be collected, the board of drainage commissioners shall have power to change or modify the assessment as originally confirmed to conform to the judgment of the Superior Court and to cover any deficit that may have been caused by the order of said court or unforeseen occurrence. The said relevy shall be made for the additional sum required, in the same ratio on the lands benefited as the original assessment was made.

SEC. 36. Fees and expenses.

Any engineer employed under the provisions of this act shall receive such compensation per diem for his services as shall be fixed and determined by the drainage commissioners. The viewers, other than the engineer, shall receive three dollars per day; the rodmen, axmen, chainmen and other laborers shall receive not to exceed two dollars per day each. All other fees and costs incurred under the provisions of this act shall be the same as provided by law for like services in other cases. Said costs and expenses shall be paid, by the order of the court, out of the drainage fund provided for that purpose, and the board of drainage commissioners shall issue warrants therefor when funds shall be in the hands of the treasurer.

Pay of engineer.
Viewers other than engineer.
Rodmen and other laborers.
Fees and costs as prescribed by law.

SEC. 37. Defects in proceedings.

The provisions of this act shall be liberally construed to promote the leveeing, ditching, draining and reclamation of wet and overflowed lands. The collection of the assessment shall not be defeated, where the proper notices have been given, by reason of any defect in the proceedings occurring prior to the order of the court confirming the final report of the viewers; but such order or orders shall be conclusive and final that all prior proceedings were regular and according to law, unless they were appealed from. If on appeal the court shall deem it just and proper to release any person or to modify his assessment or liability, it shall in no manner affect the rights and legality of any person other than the appellant, and the failure to appeal from the order of the court within the time specified shall be a waiver of any illegality in the proceedings, and the remedies provided for in this act shall exclude all other remedies.

Act to be liberally construed.

Order confirming final report conclusive.

Modification on appeal to affect appellant only.

Failure to appeal a waiver.

SEC. 38. Proceedings under this act may be *ex parte* or adversary. Any engineer, viewer, superintendent of construction or other person appointed under this act may be removed by the court, upon petition, for corruption, negligence of duties or other good and satisfactory cause shown.

Proceedings ex parte.
Removal of officers or employees for cause.

SEC. 38½. This act shall not repeal or change any local drainage laws already enacted or to be enacted by the General Assembly of one thousand nine hundred and nine.

Local drainage laws not affected.

SEC. 39. All laws in conflict with this act are hereby repealed: *Provided*, that proceedings now pending by virtue of any statute now or heretofore in force in this State in any county shall not be affected by this act, but that such proceedings may be continued in accordance with such statute or in accordance with the provisions of this act.

Repealing clause.
 proviso: proceedings pending not affected.

SEC. 40. This act shall be in effect from and after its ratification.

Ratified this the 5th day of March, A. D. 1909.

INSTRUCTIONS AND SUGGESTIONS TO ENGINEERS AND VIEWERS, IN CONNECTION WITH THE ESTABLISHMENT OF DRAINAGE DISTRICTS IN NORTH CAROLINA.

BY JOSEPH HYDE PRATT, STATE GEOLOGIST.

In order that the drainage work in North Carolina shall be carried on with some degree of uniformity, the following instructions are recommended to the engineers and viewers appointed by the clerk of the court to be followed in making surveys and reports of public drainage districts. The authority authorizing the organization of public drainage districts and the appointment of the engineer and viewers is conferred by the statute and must be strictly followed. They shall perform each and every duty that the law prescribes they shall perform, and shall not do anything or make any report other than that which is provided by the statute.

SUGGESTION TO CLERK OF COURT.

In the notice of appointment sent out by the clerk of the court notifying the engineer and viewers of their appointment, he should appoint a day when the engineer and viewers shall meet at his office and qualify for their duties. Although the law does not especially require it, it might be well for the engineer and viewers to take an oath before the clerk to faithfully and honestly discharge their duties without partiality or prejudice to any one and to the best of their knowledge and ability. The clerk should make an entry of this notice in the drainage record.

INSTRUCTIONS TO ENGINEER AND VIEWERS.

Preliminary Report.—The engineer and viewers should, as soon as possible after their appointment, fix a time and place to meet to commence the examination of the lands embraced in the petition. They should gather sufficient data from a personal examination of the lands, from the study of maps and any surveys that have been made, and by making actual surveys if they deem it necessary in order to reply directly to the four provisions, one, two, three, and four, set out in section 3 of the drainage law. These should be answered briefly and directly to the point, as follows:

1. (a) The proposed drainage is practicable, or
(b) The proposed drainage is not practicable.
2. (a) The proposed drainage will benefit the public health, or
(b) The proposed drainage will not benefit the public health.
(c) The proposed drainage will benefit one or more public highways, or
(d) The proposed drainage will not benefit any public highway.
(e) The proposed drainage will be conducive to the general welfare of the community, or
(f) The proposed drainage will not be conducive to the general welfare of the community.

3. (a) The proposed drainage will benefit the lands sought to be benefited, or
- (b) The proposed drainage will not benefit the lands sought to be benefited.
4. (a) All the lands that are benefited are in the proposed district, or
- (b) The following lands will not be benefited and should not be in the district, or
- (c) The following lands not embraced in the district will be benefited and should be included.

(Here set out a list of the lands to be omitted or included.)

A map of the proposed district should be filed with the report. It should be made to a scale and be reasonably accurate. It should show the boundary of the district, the location of ditches or levees or other improvements, natural streams, large sloughs and ponds, railroads, highways, and the relative elevation of the several parts if ascertained. The land lines need not be shown on this map and no attempt at embellishment should be made. The letters and figures should be neat, plain, and large enough to be easily read.

This report should be signed by the engineer and viewers and delivered by one of them to the clerk of the court. The landowners in the district need not be advised of the time when this report will be filed.

At the day fixed by the clerk of the court to hear and determine this report, the engineer and viewers may or may not attend as they see fit, though it is best for one or more of them to be present to explain and defend the report submitted by them. If the court approves the report, it is referred back to the engineer and viewers for a complete report.

Complete Report.—In preparing a complete report the engineer and viewers shall:

I. Make a survey of each ditch or drain by giving its course and distance and by marking it on the ground by blazing trees and planting suitable stakes and monuments. These may be placed at each 100-foot station or at the beginning and terminus and the intermediate angles or at such other points as the engineer may determine. This marking is for the purpose of showing the interested parties just where a ditch is located.

II. After the ditch is located, a line of levels must be run, giving the elevation at sufficient points to furnish an accurate profile of the surface. If any old ditch or channel is used it must be accurately cross-sectioned and the amount of excavation saved computed. Where old ditches have been excavated and the material removed has been left on the bank and it has to be rehandled in the construction of a new channel, no credit should be allowed.

III. If doubt exists as to the amount of fall or course of natural drainage for the several parts of the district, such other levels may be run as are needed to settle such points.

IV. A drainage map shall then be made on a suitable scale (about 1,000 feet per inch), showing—

- (a) Boundary of the district.
- (b) Location of all proposed work.
(This might be shown in red or some other color.)
- (c) Location of railroads and highways.
- (d) Boundaries of towns and villages, if any.
- (e) Land lines of the property within the district.

(f) Profile or general description for each ditch or other improvement.

(g) An itemized statement of the work to be done, with estimated cost of same.

(h) Total cost of the improvement.

This survey should be made by the engineer with or without the viewers. In doing this work advantage should be taken of work that has been done by the State or United States Government, and the cost should be kept as low as is consistent with good work.

V. If it is found necessary to go beyond the boundary of the district to secure a proper outlet or remove any obstruction from the stream, the engineer should show this in his report and make a survey and map showing what property would be required, so that the necessary procedure may be instituted to acquire it, either by purchase or condemnation.

VI. Any damage claimed by any one within the district (not for right of way outside of the district) must be determined by the engineer and viewers and included in their report.

VII. *Classification of Lands.*—This duty is the most difficult and the most important of any provided by the statute. It requires much judgment and discretion to perform it satisfactorily and should be given a most careful and painstaking consideration. It is solely a matter of judgment of land and land values and the increase in value that will result from the improvement. The following method of arriving at the proper classification of lands has been found satisfactory in other places and is here recommended as tending to assist the viewers to arrive at just and equitable conclusions:

On entering a tract of land the viewers should first consider it as to its degree of wetness or liability of losing a crop by being overflowed and drowned out. Each viewer should be provided with a pencil and tablet, and mark, without conference with the other viewers, his judgment as to the rating of this particular piece of land in regard to wetness on a scale of 100. Each viewer should then mark this same piece of land as to its proximity to the proposed ditch or other natural outlet, the tract lying adjacent to the ditch being marked 100 and the others correspondingly less as they are located farther away. Then the viewers should grade this same piece on a scale of 100 with reference to its fertility, the most fertile land being marked on a scale of 100 and all the other tracts correspondingly less as their fertility decreases. These three markings should be added and their sum divided by three. This will give the rating on these three points as determined by each of the viewers. If the results thus obtained by the three viewers vary materially, as they are likely to do, the matter should be discussed by them until they reach a result satisfactory to at least two of them. This rating when finally obtained will determine the class into which this tract of land should be placed.

If it is above 80 it should go in Class A;

If between 60 and 80, in Class B;

If between 40 and 60, in Class C;

If between 20 and 40, in Class D; and

If less than 20, in Class E.

The viewers should bear in mind that the point to be determined is not the whole amount of benefit that will accrue to a piece of land from the improvement, but the relative amount as compared with other lands in the same district.

VIII. When the lands are classified they should be arranged in tabulated form showing the number of acres owned by each person in each class and the total number of acres benefited in each class.

Caution.—The assessment roll or the amount of tax against each particular tract of land is not to be computed by the engineer and viewers. It has no part in their report, and by referring to section 31 of the drainage law it is clearly shown that this work is to be done by the drainage commissioners after the classification has been confirmed by the clerk of the court.

IX. Highways and railroads are not to be classified like agricultural lands, but must be examined by the engineer and viewers, and if in their judgment such highways or railroads will be benefited by the proposed improvement they should be assessed a fixed sum. In determining the amount of assessment against the public highway or railroad, only that portion of the roadbed in a district may be considered. The permanent betterment of the tangible property by the proposed improvement is the amount of benefits that the roadbed will receive. No rule can be laid down for determining this amount. It is solely a matter of judgment for the engineer and viewers. Unless the engineer and viewers are fully convinced that the highway or roadbed of the railroad will be benefited by the improvement, no assessment should be made against the property.

X. The engineer and viewers must keep an accurate account of the time employed and the expense incurred in the discharge of their duties as provided in section 13 of the drainage law. Some question has arisen as to how this compensation shall be paid. Section 2 of the drainage act provides that the drainage engineer and his assistants shall be paid by the Geological and Economic Survey, but since the Legislature failed to make any appropriation for such purpose there is no fund available and this cannot be done. Section 16 of the drainage law authorizes the clerk of the court to collect from the petitioners from time to time such amounts as may be necessary to pay cost accrued, other than that of the engineer and his assistants. Since the petitioners have a large pecuniary interest in the work, they should advance this preliminary expense. If the district is not established they are liable for this expense on their bond filed with the petition. If the district is established they can be repaid from the special assessment when it is levied and collected. It will be wise for the engineer to have an understanding with the clerk of the court and the petitioners before he accepts the appointment and enters upon his duties, as to what his compensation is to be and who is to advance it, if he is not willing to wait until the money is collected in the regular way. It is hoped that the next Legislature will appropriate a sum from which these preliminary expenses may be paid as provided in the law.

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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

ECONOMIC PAPER No. 19

FOREST FIRES IN NORTH CAROLINA DURING 1909

BY

J. S. HOLMES, Forester



RALEIGH

E. M. UZZELL & Co., STATE PRINTERS AND BINDERS

1910

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ECONOMIC PAPER No. 19

**FOREST FIRES IN NORTH CAROLINA
DURING 1909**

BY

J. S. HOLMES, Forester



RALEIGH

E. M. UZZELL & Co., STATE PRINTERS AND BINDERS

1910

NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

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LETTER OF TRANSMITTAL

CHAPEL HILL, N. C., May 1, 1910.

*To His Excellency, HONORABLE W. W. KITCHIN,
Governor of North Carolina.*

SIR:—I herewith submit for publication, as Economic Paper 19 of the reports of the North Carolina Geological and Economic Survey, a report on the Forest Fires in North Carolina during 1909, which has been prepared by Mr. J. S. Holmes, Forester to the Survey.

The statistics regarding the forest fires have been obtained largely by correspondence and in coöperation with the Forest Service of the U. S. Department of Agriculture.

Yours respectfully,

JOSEPH HYDE PRATT,
State Geologist.

TABLE OF CONTENTS.

	PAGE.
List of Illustrations	5
Preface	6
Introduction	7
Forest Regions	9
Mountain Region	10
Piedmont Region	10
Coastal Plain Region	11
Weather Conditions in 1909.....	11
Tabular Statement	12
Summary of Replies from Correspondents, by Regions (Table 1).....	12
Forest Fires in the State of North Carolina, 1909:	
Mountain Region, Table 2.....	13
Piedmont Region, Table 3.....	14
Coastal Plain Region, Table 4.....	16
Averages by Regions and State (Table 5).....	18
Analysis of Tables.....	18
Number of Fires.....	18
Area Burnt Over.....	19
Standing Timber Destroyed.....	20
Average Amount and Value of Standing Timber Destroyed per	
Acre Burned Over (Table 6).....	21
Forest Products Destroyed.....	22
Improvements Destroyed	22
Human Lives Lost.....	22
Amount Spent in Fighting Fires.....	23
Loss from Fires that is Not Covered by Questions.....	24
Timber Injured and Reduced in Value.....	24
Injury to Young Growth and Reproduction.....	25
Injury by Change in Composition of the Forest.....	26
Impoverishment of the Soil.....	27
Soil Erosion	28
Injury to Streams.....	28
Causes of Forest Fires.....	29
Causes of Fires by Forest Regions (Table 7).....	29
Unintentional Causes	30
Farmers Burning Brush, etc.....	30
Hunters	31
Campers	31
Matches	32
Railroads	33
Lumbering	34
Sawmills	34
Intentional Fires	35
Protection Fires	35
"Improving" the Range.....	36

Causes of Forest Fires—*Continued.*

	PAGE.
Intentional Fires :	
Chestnut Gatherers	37
No Particular Reason	37
Malice	38
Unknown Causes	39
Prevention of Forest Fires	40
Public Opinion	40
Stock Law	41
Fire Laws	42
Railroads	42
Fire Protection	43
Fire Lines	43
Fire Patrol	44
Fire Notices	44
Extinguishing Fires	47
Conclusion	48

LIST OF ILLUSTRATIONS.

PLATE	Facing Page
I. Our vanishing hardwood supply emphasizes the increasing necessity for fire protection. Virgin white oak, 200-300 years old, Buncombe County, N. C. Such large trees are rarely killed by the common surface fires.....	7
II. The result of spring fires in the Coastal Plain region: A, A grove of longleaf pine 15-20 feet high burnt to the top and killed. B, Large oak trees just coming into leaf killed by surface fires..	20
III. One result of burning the woods. Mature longleaf pine timber destroyed by fire getting into old boxes.....	20
IV. How surface fires destroy mature timber. Base of pine tree burnt through by fire in the boxes. This will blow down, or be burnt down by the next fire.....	22
V. The increasing necessity for fire protection. Our future hardwood supply, showing reproduction of white oak, Buncombe County, N. C. Surface fires would absolutely destroy or vitally injure these young trees.....	24
VI. Two ways of treating a cut-over forest: A. Hardwood forest burnt over after logging, Watauga County, N. C. All reproduction and most of the second growth has been killed. B, Hardwood forest protected from fire. Thrifty yellow poplar reproduction, Buncombe County, N. C. A forest fire would destroy this growth	26
VII. Longleaf pine forest. Seedlings of longleaf pine up to six years of age killed by surface fire.....	26
VIII. A, Effects of boxing and fire. Pine forests laid waste in Coastal Plain region. B, Fire protection. Road used as a fire-break with complete success in a longleaf pine forest.....	40
IX. Fighting fire with the plow. Surface fire in pine forest stopped by plowing two double furrows.....	42

PREFACE.

On account of the enormous loss that North Carolina sustains each year as a result of forest fires, the North Carolina Geological and Economic Survey decided to make an investigation regarding the number of forest fires, the amount of damage resulting from them, their causes, and whether it would have been possible to have prevented any of them. The information has been obtained largely by correspondence and in coöperation with the Forest Service of the U. S. Department of Agriculture, which is collecting similar statistics from all over the country.

Although we were not able to obtain as full information as was desired, yet the statistics that have been collected are of considerable importance and show the need of some legislation to prevent as much as possible this enormous waste that is caused each year by forest fires.

It is hoped that this report will be the means of awakening our people to the realization that forest fires are causing a heavy loss to the State each year and that some legislative action is necessary to remedy this.

JOSEPH HYDE PRATT,
State Geologist.

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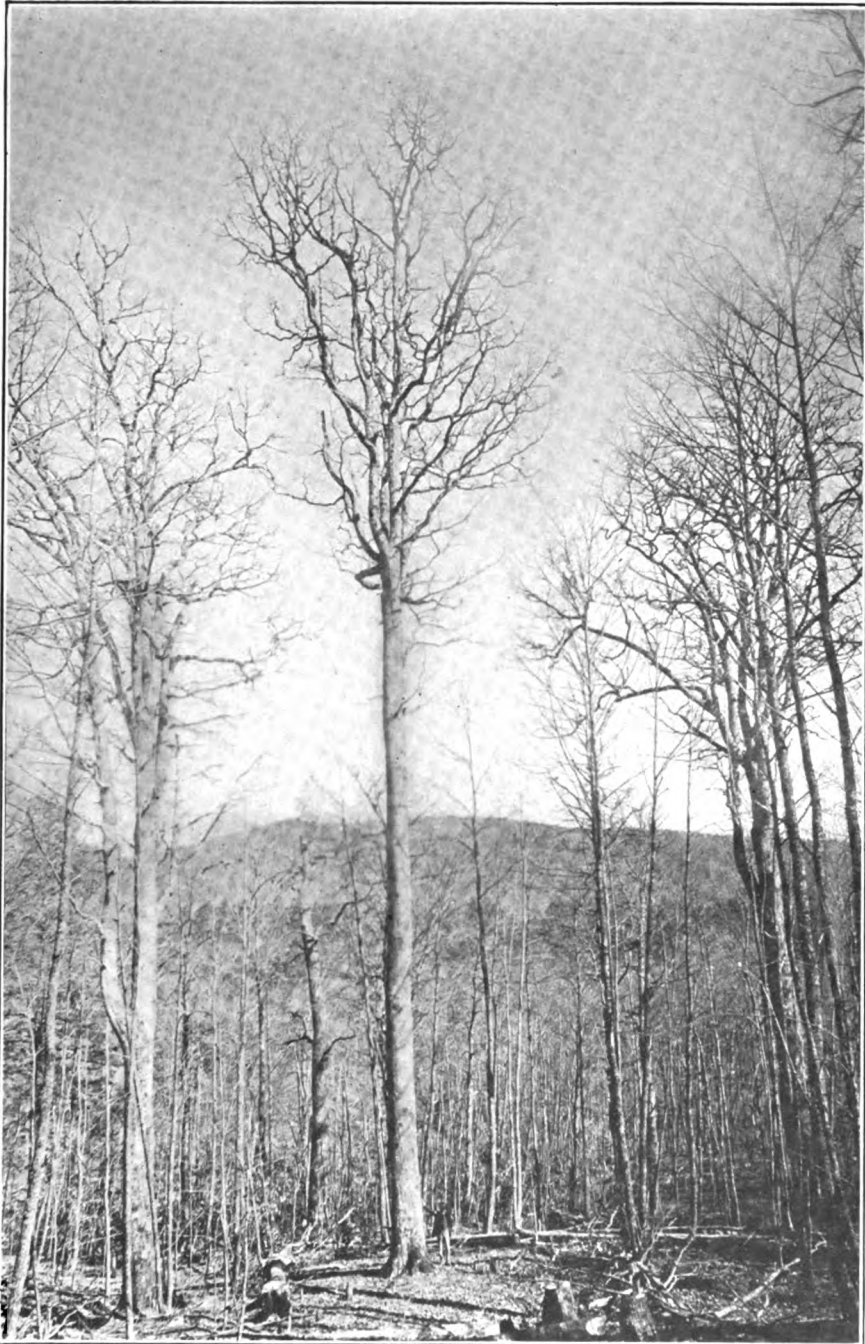


PLATE I. OUR VANISHING HARDWOOD SUPPLY EMPHASIZES THE INCREASING NECESSITY FOR FIRE PROTECTION. VIRGIN WHITE OAK, 200-300 YEARS OLD, BUNCOMBE COUNTY, N. C. SUCH LARGE TREES ARE RARELY KILLED BY THE COMMON SURFACE FIRES.

FOREST FIRES IN NORTH CAROLINA DURING 1909.*

By J. S. HOLMES, FORESTER.

INTRODUCTION.

Fire is undoubtedly the greatest enemy to the forest. It is estimated by the National Conservation Commission, in its report recently published, that the direct loss in the United States caused by the destruction of standing timber by fire has averaged \$50,000,000 a year for the past thirty years. This takes no account of the destruction of young growth and other injuries which the forest sustains from fire, which, if it could be estimated, would at least double this figure.

According to the census of 1880, 546,000 acres of forest land in North Carolina were burned over the previous year, involving a property loss alone of \$357,000. This estimate was based on circular-letters of inquiry sent out to correspondents in all parts of the State, and not on a house-to-house canvass, as the other census figures usually are. Many counties were not heard from at all, and the information from others was discarded as being contradictory or of doubtful accuracy. For this reason these figures were in all probability much too low.

In 1894 an attempt was made by the North Carolina Geological Survey to collect data on forest fires and get an estimate of the annual damage done by them to the forests of the State. This, also, was done by correspondence, and many of the counties were not heard from at all. The results of this inquiry were published in Bulletin 7 of the North Carolina Geological Survey and were summarized by the author, Mr. W. W. Ashe, then in charge of Forest Investigation, as follows:

The damage as stated by the correspondents from the several reporting counties must have aggregated over \$400,000, and there must have been between 800,000 and 1,200,000 acres burned over during the year. It is difficult to fix any standard by which losses can be ascertained; for only mature trees of certain merchantable species are considered in making the estimates, while the destruction of kinds with no commercial valuation as yet, and young growth, is counted as nothing. The counties reporting embraced only about one-half of the area of the State, and the writer from his own observation of the damage wrought in previous years in these nonreporting counties would estimate the damage of them at over one-half of what it is in the other counties, or over \$200,000. The entire loss in 1894 caused by forest fires in the State was certainly not less than \$600,000; and from 1,500,000 to 2,000,000 acres of forest and waste lands were burned over.

*The statistics used in this report have been collected by the United States Forest Service in co-operation with the North Carolina Geological and Economic Survey.

One of the greatest obstacles which we have to encounter in our fight for the control and prevention of forest fires is the lack of reliable statistics on this question. Most people have a vague sort of idea that serious fires, which do not occur very often, do considerable damage, and that light grass or leaf fires, though they are very common, do little or no damage—in fact, are hardly of enough importance to be classified as forest fires. This can be gathered very readily from the replies of many of our correspondents. But when it comes to estimating the annual damage caused by forest fires in the State or in any one county or township, or even telling what was the actual damage caused by any one fire, even the most intelligent and wide-awake citizens seem unable to do it.

The estimated damage done to our forests by fire fifteen or thirty years ago carries little weight with the average man when used as an argument for present and immediate action. What is wanted to impress the people with the importance of this subject and the crying need for a united effort to curtail this enormous annual waste are figures as up to date and as accurate as it is possible to procure.

In the fall and winter of 1908, an attempt was made by the Forest Service of the United States Department of Agriculture to procure figures as to the extent and seriousness of forest fires in every State in the Union for the use of the National Conservation Commission. For many of the States, North Carolina among the number, it was found that no figures were available, so that, in compiling the fire damage for the whole country, often the roughest estimates had to be used.

In the summer of 1909, the Forest Service asked the coöperation of the North Carolina Geological and Economic Survey in the collection of forest-fire statistics for that year in this State. The Survey was not only willing, but anxious, to procure these figures, so was very glad to coöperate with the Federal Government in this work. A circular-letter was sent out to six or eight of the leading men in every county of the State, telling them that at the end of the year a blank form would be sent them with a request to answer certain questions relating to forest fires, and asking them in the meantime to institute inquiries and make notes on any fires that might come to their notice. Early in December the blank form was sent to these correspondents, accompanied by a letter asking them to give as accurate information as possible, and, where accurate information could not be obtained, to make a careful estimate of the injury done by forest fires in their county or township.

In order that the results obtained may be better understood, the form as sent to these correspondents is here given:

FOREST FIRES IN THE STATE OF NORTH CAROLINA, 1909.

1. To what county (or township) do the statistics given below apply?.....
2. How many different forest fires have you had during the year 1909?.....
3. What was the total acreage burned over in your county during the past year?.....
 - a. Number of acres of forest land growing merchantable timber?.....
 - b. Number of acres in second growth that was not yet merchantable?.....
 - c. Number of acres of cut-over land?.....
4. How much merchantable standing timber has been destroyed by fire? Give amount in board feet
5. What was the approximate value of this timber as it stood?
6. What is the value of all forest products, such as sawlogs, lumber, ties, etc., that were destroyed?
7. What is the value of all improvements, such as fences, barns, houses, mills, etc., and of live stock that was destroyed?
8. Have any human lives been lost? If so, how many?
9. State as close as possible what it has cost private individuals, lumber companies, and others to fight forest fires in your county
10. What were the causes of the forest fires?

Out of upwards of 600 persons all over the State to whom these questions were sent, scarcely more than 150 sent in replies of any kind, even though a second call was made to counties not reporting at first. Many of the replies were incomplete, the correspondents answering only part of the questions. The data submitted, however, though meager and insufficient, have been tabulated according to counties and regions. In many cases the figures given refer to only one or two townships in a county; but, for lack of more complete information, these have been used in nearly every instance just as received. It must be borne in mind that, on an average, less than two reports have been received from each county for which figures are given, and that only four counties were reported on by more than three persons.

The actual figures are published here, not so much to give an accurate estimate of the amount of damage done by forest fires in 1909 as for the purpose of calling the attention of the people of North Carolina to this great waste that is going on all the time, so that they can use what means they have in their power to stop it.

FOREST REGIONS.

In order that a better understanding of the figures may be had and that more intelligent deductions may be drawn from the tables presented, a brief description of the forest regions of the State is here given.

Mountain Region.—This includes all the counties west of the Blue Ridge. The country is, on the whole, rugged and broken with high mountains, steep slopes and usually narrow valleys. In spite of this, however, about one-fourth of the area has been cleared for cultivation. The forests, which almost exclusively occupy absolute forest land, are of two formations. The *spruce* formation, of which there is only a comparatively small area, occupies the tops and upper slopes of many of the higher mountains. These spruce forests in their virgin condition, catching as they do much rainfall that would not be precipitated on the lower altitudes, are usually so moist that they are little subject to forest fires. When, however, they are cut over, as some of them have been during the last few years, for pulp and lumber, the surface soil dries out and the laps and tops become very inflammable. Where fires burn over these slashings, not only is the young growth and reproduction all destroyed, but even the soil, which is chiefly vegetable mold, is burnt up, so that the area is reduced to a barren waste, and there is little chance of its further usefulness, either as a producer of timber or, which are its much more important functions, as a preventer of erosion and a regulator of stream flow. Fire should be kept out of this type at all costs, as burning it is most disastrous. Much the greater part of the forest, however, in this region consists of the *hardwood* formation, chestnut and the oaks being the chief trees. There will be found occasional mixtures of the pines and hemlock, and even some small areas of pure forests of these species on grown-up old fields or cold north slopes, but these are not permanent enough or distinct enough to be separated as definite types. Forest fires in these hardwoods are usually surface or leaf fires, though occasionally on the higher mountains, where decomposition of the leaf mould takes place slowly, a fire in a dry time will consume all the humus and much of the surface soil. Though these fires usually only kill mature timber when they come late in the spring, after the sap has started to rise, still every fire does very great damage to the old timber, to reproduction, and to the soil, all of which is hard to calculate in dollars and cents.

Piedmont Region.—The forests of the Piedmont Plateau are usually hardwood, with the oak predominating, or mixed hardwood and pine. In the western part of the region they occupy the steeper mountain slopes, often in large continuous areas. Farther east, however, where the larger part of the land is cleared for agriculture, the forest areas are chiefly woodlots belonging to the different farms, and occupying land that is not wanted for cultivation, or in many cases is too rough for profitable farming. Here fires become scarcer because these small

areas are more easily protected and controlled by their owners, and because, the stock being kept up, there is less inducement to burn the woods for the range.

Coastal Plain.—This forest region occupies a belt averaging about 100 miles wide, along and parallel to the coast, and corresponding with the "coastal plain" geological formation. This area was originally covered by a pure forest of longleaf pine, with hardwood swamps along the water-courses. The pinelands have practically all been cut over, though on some of them a second growth of loblolly pine, much of which is now merchantable, has taken its place. Through these broken pine stands and the very open cut-over lands, wild grasses flourish. It is these grasses, after being dried out by the frost, together with the fallen pine leaves, which feed the frequent, almost annual, fires. These fires, though seldom seriously injuring mature, round timber, are a great menace to boxed timber, and also go far toward preventing any kind of pine reproduction.

The swamp areas in this region are usually too wet to burn, but during occasional very dry seasons they will catch fire and not only the accumulation of leaves, grass, and brush will burn, killing the young growth and reproduction, but in the drier parts the soil burns, and causes the destruction of considerable timber by undermining the roots.

WEATHER CONDITIONS IN 1909.

The weather conditions have much to do with the frequency and destructiveness of forest fires. In considering this subject it is well, therefore, to keep in mind the prominent features of the weather, more especially of rainfall, during the year under discussion.

According to the annual report of the North Carolina Section of the Weather Bureau, the average precipitation for the State in 1909 was 47.78 inches, which was 10 inches less than during the preceding year and 3 inches below normal, which is the average of all the years for which the records have been kept. The first three months of the year were drier than usual over the greater part of the State, the rainfall for this period being considerably below normal. In the mountains the precipitation was about normal through February and March, but during April this part of the State was rather dry. In May the rainfall was 1 inch below the normal in the eastern district, above normal in the central, and 3 inches above normal in the western district. June was the wettest on record, the average rainfall for the month being 7.92 inches, and going as high as 17.05 inches at one station near the coast. During July and August the precipitation was about normal all over the State. In September a droughty condition commenced in the

eastern and central districts, which lasted up till the middle of December. During this season there were no general rains over the eastern and central districts. This did not seriously affect the mountain counties, though November was exceptionally dry all over the State.

This long dry fall made a season exceptionally conducive to forest fires. In a year of normally distributed rainfall it is probable that the injury from fires might be considerably less.

TABULAR STATEMENT.

That the general distribution over the State of the damage from forest fires may be better realized, and in order to furnish a basis of comparison for future reports, the following tables are given. It must, however, be remembered that the figures are not actual areas and losses, but are in most cases but rough estimates made by correspondents in the different parts of the State and are probably in most cases too low.

TABLE 1.—SUMMARY OF REPLIES FROM CORRESPONDENTS, BY REGIONS.

	Mountain Region.	Piedmont Region.	Coastal Plain Region.	State.
1. Total number of replies.....	47	61	50	158
2. Total number of fires reported.....	249	86	272	607
3. Total area burnt, in acres.....	166,295	100,670	139,100	406,065
3a. Total area burnt of growing, merchantable timber, in acres.....	128,145	77,735	51,025	256,905
3b. Total area burnt of second growth, not yet merchantable, in acres.....	13,100	14,555	27,050	54,705
3c. Total area burnt of cut-over land, in acres.....	25,050	8,380	61,025	94,405
4. Total standing timber destroyed in M bd. ft....	17,325	11,027	9,280	37,632
5. Value of timber destroyed, in dollars.....	\$ 47,520	\$ 33,374	\$ 26,360	\$107,254
6. Value of products destroyed, in dollars.....	\$ 17,075	\$ 39,425	\$ 30,245	\$ 86,745
7. Value of improvements destroyed, in dollars..	\$ 26,550	\$ 14,750	\$ 17,105	\$ 58,405
9.* Total cost to fight fires, in dollars.....	\$ 6,650	\$ 1,059	\$ 6,355	\$ 14,064

*The answers to Question 8 (Have any human lives been lost? If so, how many?) have been omitted from these tables because no lives were reported lost from forest fires in this State during 1909.

TABLE 2.—FOREST FIRES IN THE STATE OF NORTH CAROLINA, 1909. SUMMARY OF REPORTS FROM CORRESPONDENTS, BY COUNTIES.
MOUNTAIN REGION.

COUNTY.	Number of Repleas.	Number of Fires.	Total Area Burnt—Acres.	Total Merchantable Timber Burnt—Acres.	Total Second Growth Burnt—Acres.	Total Cut-over Land Burnt—Acres.	Merchantable Timber Destroyed in M Bd. Feet.	Value of Timber Destroyed.	Value of Products Destroyed.	Value Improvements Destroyed.	Cost to Fight Fires.
Alleghany.....	2	2	100	100	---	---	5	\$	10	\$	---
Ashe.....	1	1	200	200	---	---	10	40	1,000	500	---
Buncombe.....	6	15	7,100	4,100	2,300	700	2,500	6,000	500	7,250	2,000
Cherokee.....	3	20	30,000	20,000	5,000	5,000	5,000	15,000	---	---	---
Clay.....	3	100	15,000	10,000	---	---	1,000	1,000	5,000	6,000	2,000
Graham.....	3	10	50,000	50,000	---	---	100	100	500	600	---
Haywood.....	3	5	10,000	9,000	---	1,000	200	800	2,000	1,000	500
Henderson.....	5	15	8,320	4,270	800	3,250	600	600	---	100	75
Jackson.....	3	15	2,000	2,000	---	---	2,000	6,000	---	---	75
Macon.....	1	1	10,000	5,000	---	5,000	10	20	---	---	---
Madison.....	1	---	---	---	---	---	---	---	---	---	---
Mitchell.....	3	4	1,000	1,000	---	---	---	---	---	---	100
Swain.....	5	50	30,000	20,000	5,000	5,000	5,500	17,500	7,500	10,000	1,250
Transylvania.....	2	5	2,075	2,075	---	---	100	200	---	100	---
Watauga.....	5	6	500	400	---	100	300	250	375	500	150
Yancey.....	1	---	---	---	---	---	---	---	---	---	---
Total.....	47	249	166,295	128,145	13,100	25,050	17,325	47,520	17,075	26,550	6,650

TABLE 3.—FOREST FIRES IN THE STATE OF NORTH CAROLINA, 1900. SUMMARY OF REPORTS FROM CORRESPONDENTS, BY COUNTIES.
PIEDMONT REGION.

County.	Number of Replies.	Number of Fires.	Total Area Burnt— Acres.	Total Mer- chantable Timber Burnt— Acres.	Total Second Growth Burnt— Acres.	Total Cut-over Land Burnt— Acres.	Merchantable Timber Destroyed in M Bd. Feet.	Value of Timber Destroyed.	Value of Products Destroyed.	Value Improve- ments Destroyed.	Cost to Fight Fires.
Alamance.....	3	6	200	75	75	50		\$ 500	\$ 700	\$ 1,000	\$ ---
Alexander.....	3	2	1,000	500	500						20
Anson.....											
Burke.....	3	15	70,000	65,000		5,000	15,000	2,250	20,000	7,000	200
Cabarrus.....	1	1	20	10	10						5
Caldwell.....	1	4	700	300	250	150	75	300	400	200	100
Caswell.....	1										
Catawba.....	1	3	150	50	70	30	300	750	400	100	
Chatham.....	1										
Cleveland.....	2										
Davidson.....	1	1	150	100	50		150	600	800	200	50
Davie.....	3	3	300	100		200				500	
Durham.....											
Forsyth.....	3										
Franklin.....	1										
Gaston.....	2										
Granville.....	1	3	100	50	50						
Guilford.....	2										
Iredell.....	1	4	1,000	500	500		3,000	15,000	2,000	5,000	12
Lee.....											
Lincoln.....											
McDowell.....	1	4	5,000	2,000	3,000		5,000	10,000	10,000		50
Mecklenburg.....	1										
Montgomery.....	2	6	15,300	3,500	10,000	1,800	10	25	500	500	312
Moore.....	1	8	1,000	500		500	102	884	1,125		
Orange.....	2	1	300	300							60
Person.....	2	1	50	10	40						
Polk.....	2	6	4,500	4,000		500	200	400	500	200	100

FOREST FIRES IN NORTH CAROLINA.

TABLE 4.—FOREST FIRES IN THE STATE OF NORTH CAROLINA, 1900. SUMMARY OF REPLIES FROM CORRESPONDENTS, BY COUNTIES.
COASTAL PLAIN REGION.

COUNTY.	Number of Replies.	Number of Fires.	Total Area Burnt—Acres.	Total Merchantable Timber Burnt—Acres.	Total Second Growth Burnt—Acres.	Total Cut-over Land Burnt—Acres.	Merchantable Timber Destroyed in M Bd. Feet.	Value of Timber Destroyed.	Value of Products Destroyed.	Value Improved—ments Destroyed.	Cost to Fight Fires.
Beaufort.....	3	5	3,000	3,000	—	—	—	\$ 2,000	—	\$ 1,000	\$ —
Bertie.....	2	4	1,000	800	—	200	10	30	1,000	500	100
Bladen.....	3	4	6,000	5,800	—	200	4,000	6,000	100	1,000	200
Brunswick.....	—	—	—	—	—	—	—	—	—	—	—
Camden.....	—	—	—	—	—	—	—	—	—	—	—
Carteret.....	—	—	—	—	—	—	—	—	—	—	—
Chowan.....	—	—	—	—	—	—	—	—	—	—	—
Columbus.....	1	6	500	400	100	—	20	30	45	5	5
Craven.....	1	20	10,000	2,000	2,000	6,000	—	—	—	—	500
Cumberland.....	1	3	100	50	25	25	50	250	—	—	50
Currituck.....	2	—	—	—	—	—	—	—	—	—	—
Dare.....	1	—	—	—	—	—	—	—	—	—	—
Duplin.....	—	—	—	—	—	—	—	—	—	—	—
Edgecombe.....	1	4	50	50	—	—	—	—	—	—	—
Gates.....	1	12	2,000	1,000	500	500	150	500	1,200	200	200
Greene.....	—	—	—	—	—	—	—	—	—	—	—
Halifax.....	—	—	—	—	—	—	—	—	—	—	—
Harnett.....	1	5	10,000	2,000	2,000	6,000	1,000	1,000	2,000	—	—
Hertford.....	1	9	3,700	2,000	1,700	—	500	4,000	5,000	6,000	1,000
Hyde.....	3	—	—	—	—	—	—	—	—	—	—
Johnston.....	—	—	—	—	—	—	—	—	—	—	—
Jones.....	1	2	20,000	5,000	5,000	10,000	500	1,000	15,000	2,000	2,000
Lenoir.....	1	12	1,000	500	500	—	—	—	—	—	—
Martin.....	1	6	7,000	3,500	1,000	2,500	—	—	5,000	500	—
Nash.....	1	15	1,500	1,000	500	—	—	—	—	—	—
New Hanover.....	—	—	—	—	—	—	—	—	—	—	—
Northampton.....	2	6	250	175	25	50	100	200	—	100	25
Onslow.....	1	5	15,000	8,000	5,000	2,000	—	—	—	—	—

FOREST FIRES IN NORTH CAROLINA.

17

Pamlico.....	1	50	8,000	3,000		5,000	100	400	50	1,000	
Pasquotank.....	2										
Pender.....	1	50	20,000	7,000	6,000	7,000	300	600	400	3,000	500
Perquimans.....	2										
Pitt.....	1	4	5,000	2,000	2,000	1,000				1,000	500
Richmond.....	2	10	20,000	2,000		18,000	1,000	4,000		150	
Robeson.....	3	24	1,500	800	400	300	50	100	100		
Sampson.....	1										
Scotland.....	1	5									
Tyrrell.....	3	10	1,000	750		250	500	1,250	350	500	1,250
Washington.....	3	1	2,500	200	300	2,000	1,000	5,000		150	25
Wayne.....	2										
Wilson.....											
Total.....	50	272	139,100	51,025	27,050	61,025	9,280	26,360	30,245	17,105	6,355

TABLE 5.—AVERAGES BY REGIONS AND STATE (DEDUCED FROM TABLE 1).

	Mountain Region.	Piedmont Region.	Coastal Plain Region.	State.
Total number of counties in State and region.....	16	41	41	98
Number of counties not reporting.....		4	10	14
Number of counties reporting no fire.....	2	15	7	24
Number of counties reporting fires.....	14	22	24	60
Average number of fires per county reporting.....	15	2	9	7
Average area burnt per county reporting, in acres.....	10,393	2,721	4,810	4,803
Average damage per county reporting, in dollars.....	\$ 6,112	\$ 2,397	\$ 2,562	\$ 3,177
Average area of each fire, in acres.....	668	1,171	511	667
Average damage by each fire, in dollars.....	\$ 393	\$ 1,030	\$ 294	\$ 439
Average damage per acre, in cents.....	.59	.88	.57	.66

It can be readily understood that the figures given in these tables in almost all cases considerably understate the actual facts. This is so, partly because there is a tendency to underestimate damage that does not directly affect oneself, and partly because the observations of most people do not as a rule cover more than the immediate neighborhood in which they live, and in many cases the correspondents have only attempted to report for one township. This is also due to a considerable extent to the fact, elsewhere commented on, that many people do not seem to classify as forest fires ordinary grass or leaf fires that are set with some particular object in view.

ANALYSIS OF TABLES.

NUMBER OF FIRES.

From the tables it will be seen that over 600 forest fires were reported for the State, or an average of about seven fires per county reporting. That this does not adequately represent the actual number of fires which occurred can be judged from the fact that even in those counties best represented by correspondents, only a small part of the county was covered by the report. In Buncombe County, for example, the county reported on by the largest number of correspondents, who listed twice the average number of fires for the State, less than one-third of the townships were reported on. The adjoining county of Henderson also reported twice the average number of fires, yet only half the townships were reported on by a number of correspondents, second only to Buncombe. It is obvious, then, that in the middle and eastern parts of the State, where only one or two and at the most three correspondents were heard from in a county, the territory must have been even more inadequately covered.

Attention is called to the contrast between the number of fires per county reported for the Piedmont region and for the regions to the east

and west of it. The actual difference is probably not so great as is indicated, but these figures give a fairly correct idea of the difference in conditions, due chiefly to the closed range in the Piedmont region.

AREA BURNT OVER.

From the tables it appears that a much larger area was burnt over in the mountain counties than in either of the regions to the eastward. Over 166,000 acres were reported burnt over, which is approximately 5 per cent of the total forest area of the region. While this is in all probability too low, it is much nearer the actual figure than is that for the Coastal region. In the eastern part of the State the replies represented such a comparatively few of the townships that the results are far from satisfactory. There was unfortunately much less interest manifested in the forest-fire question in this part of the State than in the hardwood region, though to the pine forests it is, if possible, of even greater importance.

The reason that the proportion of land growing merchantable timber which was burnt over was so much greater in the mountain counties is that so little of the forest area of this region is really destitute of timber that is salable in some form. The usual method of cutting in this region is to select the timber that will bring the best price at the time, and leave the rest for a future cutting. Usually, only forests logged by some large lumber company, where practically everything is taken, can be really classified as cut-over land.

Again, practically all hardwood forests contain some second growth, for very few of them are actually virgin, and it is often very difficult to determine to which of the classes named in the list of questions a given piece of woods belongs. Definitions of these three classes of forests, as applied to the hardwoods, are here given, though it must be remembered that no hard and fast rule can be made that can be applied to every case.

Forest growing merchantable timber is that forest which contains a sufficient amount of merchantable timber to justify a sawmill man or other operator going onto that land and conducting a profitable logging or other operation on the tract. "Merchantable" timber is timber that can *profitably* be turned into lumber, staves, ties, or other salable forest products.

Cut-over forest, for the purpose of this study, can be defined as that forest which has had so much of the merchantable timber cut from it that it will not pay a sawmill man or other operator to log the land, because what merchantable timber has been left is too scattered or of too small a quantity to make it profitable.

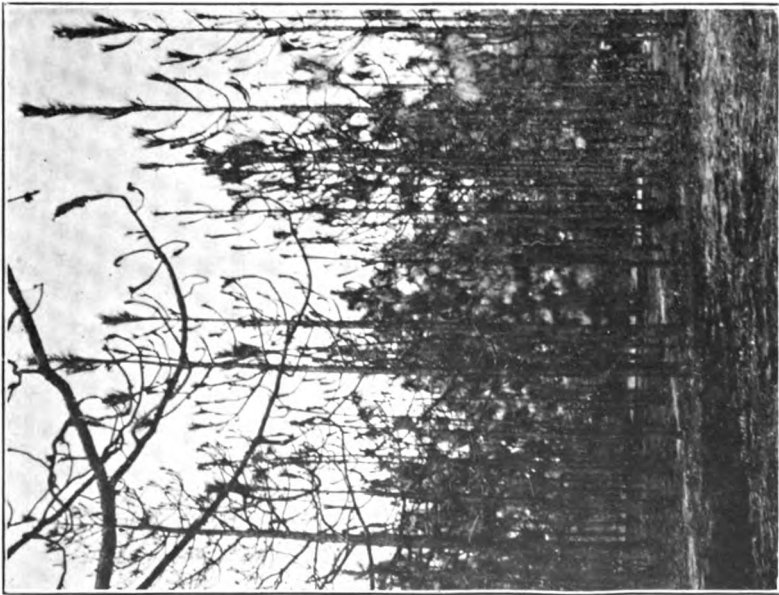
Cut-over land should, however, be classified as a *second-growth forest* if it supports 50 per cent or larger part of a full stand of second growth, namely, young trees of those species which when mature will be merchantable. If left to itself and fire is kept out, cut-over land will, at least in the hardwood type, rapidly become second growth; but, if repeatedly burnt over so that only worthless species, such as sassafras, sumach, sourwood, and black gum come up, it will in all probability remain cut-over land. Again, an old field grown up to half or more than half a full stand of pine or hardwood would be classified as a second-growth forest, though with much less density than that it would probably still be called old field. Young growth would not be called second growth until at least enough of it to form half a stand is as large as 4 inches in diameter.

This difficulty of classification is not so marked in the pine region. The present methods of lumbering generally remove all the merchantable timber in one operation, so that there is a pretty clear and sharp distinction between merchantable forest and cut-over land. On much of the cut-over pine land second growth has come in, and in such cases the distinction between the two must be more or less arbitrary, as suggested above.

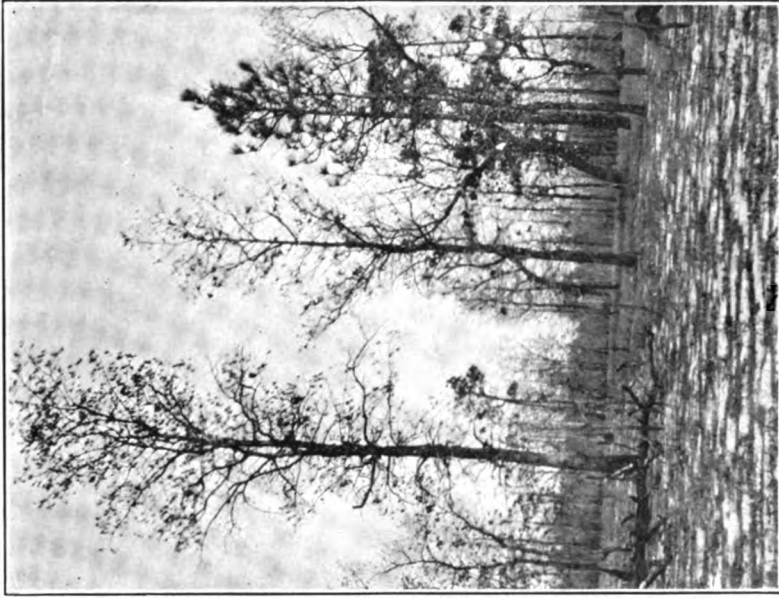
STANDING TIMBER DESTROYED.

Where the woods are burnt annually during the winter, mature standing timber is seldom absolutely destroyed by forest fires, and this is the strongest argument in favor of the practice of burning. The disadvantages of burning, however, as discussed on another page, so far outweigh this one advantage that the owners of forest lands should be most reluctant to resort to it. If, on the other hand, a fire gets out in the spring, after the sap starts to rise and the buds on the trees are swelling or opening, the mature timber is very likely to be killed. This is especially true of the hardwood forests, where most of the timber destroyed is killed in this way.

In the Coastal region, also, much standing timber is killed by late spring fires, but there are two other important ways in which pine timber is destroyed by fire. Where fire gets out in a turpentine orchard that is being worked, or in one worked out that has not been lumbered, great destruction results. The fire gets into the boxes and eats into the base of the tree, and the tree is either killed or burnt down at once, or is so weakened that it is later blown down. Probably more longleaf pine timber has in the past been destroyed in this way than has been cut by the lumberman. And though, in present practice, lumbering usually quickly follows turpentineing, still much timber is even yet destroyed by this means every year. The old method of turpentineing is being super-



A.



B.

PLATE II. THE RESULT OF SPRING FIRES IN THE COASTAL PLAIN REGION: A, A GROVE OF LONGLEAF PINE 15-20 FEET HIGH, BURNT TO THE TOP AND KILLED. B, LARGE OAK TREES JUST COMING INTO LEAF, KILLED BY SURFACE FIRE.

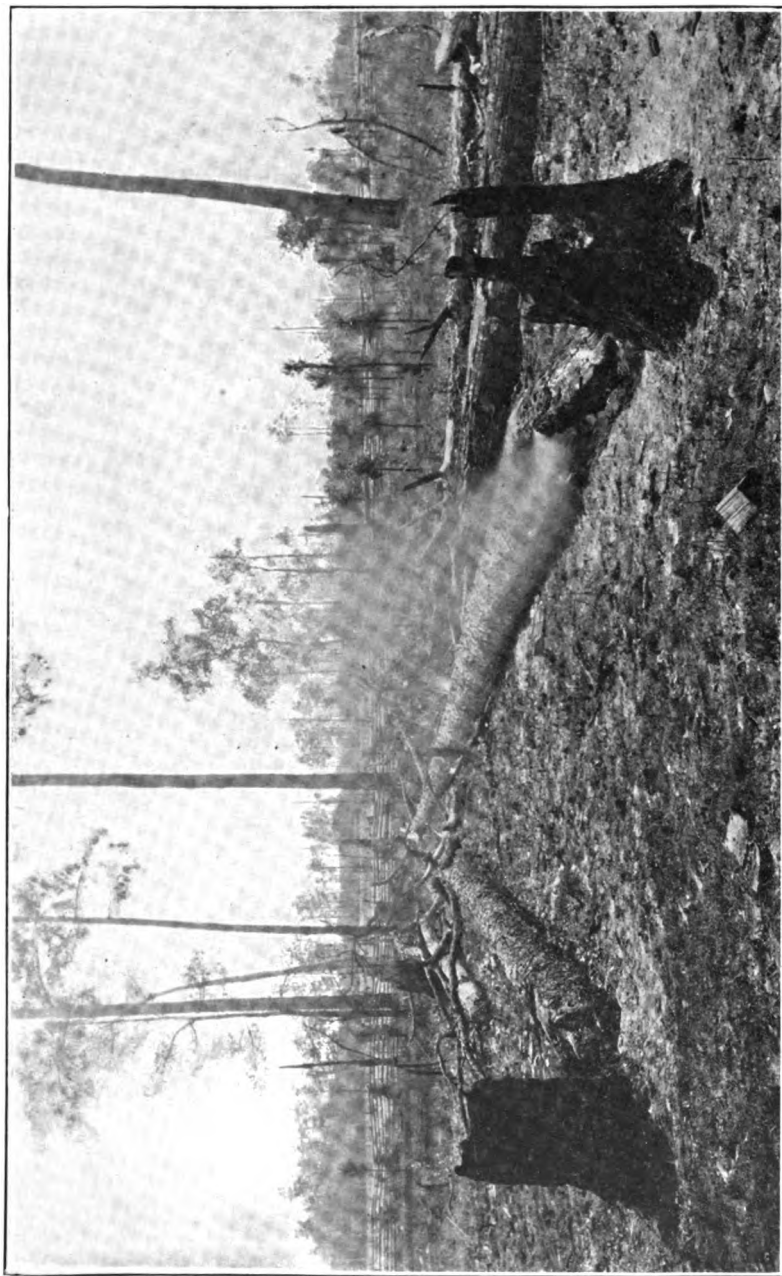


PLATE III. ONE RESULT OF BURNING THE WOODS. MATURE LONGLEAF PINE TIMBER DESTROYED BY FIRE GETTING INTO OLD BOXES.

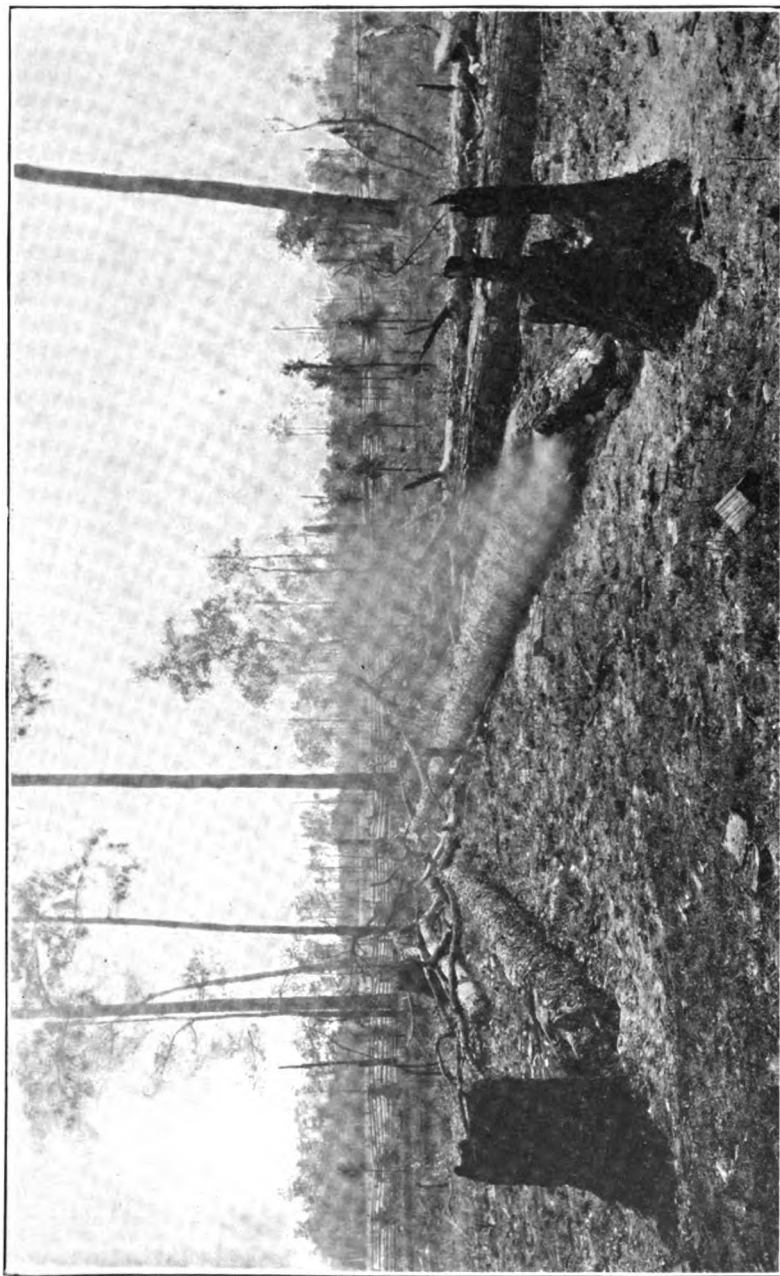


PLATE III. ONE RESULT OF BURNING THE WOODS. MATURE LONGLEAF PINE TIMBER DESTROYED BY FIRE GETTING INTO OLD BOXES.

seded by the modern cup-and-gutter system in most large operations, especially in the States to the south of us, and where this is used the fire risk is thereby greatly reduced. There is no reason why the small operator in our own State who works only a few hundred trees as a side issue should not take advantage of this most valuable improvement.

In exceptionally dry seasons, such as the past fall, many swamps and lowgrounds get dry enough to burn readily. Even the soil, which in such places is largely composed of vegetable matter, will at such times catch fire and burn for days. In this way a great many trees are thrown, by having the ground burnt from under them, and, though the trees themselves may not be burnt up, they will soon be destroyed by insects and fungus diseases. The loss, however, to the soil by burning these lowlands is often greater even than that to the timber.

Though undoubtedly far below the actual figures, the estimates in the previous tables of the amount and value of standing timber destroyed probably come nearer to the actual facts than those given for area burned over. The most destructive fires are the ones that are most likely to be reported, and the sometimes rather exaggerated estimate of injury done, when a man is reporting on his own loss, may partly, at least, compensate for the large number of fires that are not reported at all. It will, therefore, be interesting to compare these figures for the different regions of the State.

The following table (6) is based on the figures given previously in Table 1:

TABLE 6.—AVERAGE AMOUNT AND VALUE OF STANDING TIMBER DESTROYED PER ACRE BURNED OVER.

	Amount of Timber Destroyed (in Feet Board Measure) per Acre of Land Con- taining Merchant- able Timber.	Amount of Timber Destroyed (in Feet Board Measure) per Acre Burned Over.	Average Stumpage Value (in Cents) of Standing Timber Destroyed, per Acre Burned Over.
Mountain region.....	134	104	29
Piedmont region.....	142	110	33
Coastal region.....	182	67	19
State.....	146	93	26

One of the most noticeable things which this table brings out is the comparatively little variation for the different regions of the State. The amount of timber destroyed per acre and the average value of it are almost identical in the two hardwood regions, being slightly greater

in the Piedmont region, which might be expected, owing to the rarer occurrence of fires. In the Coastal region the amount of timber destroyed per acre of merchantable timber land burned over is somewhat greater, though compared to the total area burned over it is considerably less. This difference is due chiefly to the larger proportion of cut-over land in the burned area of this region.

FOREST PRODUCTS DESTROYED.

One very serious loss resulting from forest fires is the destruction of various forest products, either manufactured or in the process of making, but not yet hauled from the woods. Sawlogs cut and yarded; lumber yarded, but not disposed of; ties, staves, and shingles made and stacked up in the woods to season or to await a favorable time for hauling; cordwood for fuel, pulp, or extract wood waiting for an improvement in the market or the roads; tanbark, poles, posts, and various other products of the forests of the State, on which much labor has been expended, are destroyed every year in large quantities by forest fires. This loss, with ordinary care and foresight, should be prevented.

From Table 1 it is seen that about \$85,000 was lost in this way in 1909; that is, every forest fire reported destroyed on an average \$140 worth of such products.

IMPROVEMENTS DESTROYED.

Probably the most common and widely distributed direct loss from forest fires, outside of that from standing timber, is in the destruction of fences. Fifty-six thousand dollars was lost in 1909 by the burning of improvements, the greater part of which were probably fences. Some sheds, barns, and other outbuildings and even a house or two were burnt. Practically all this loss was due to carelessness in setting out and handling fires, and might and should have been prevented.

HUMAN LIVES LOST.

In the coniferous forests of many of the northwestern States forest fires sometimes rage so furiously that not only is the property loss enormous, but there is occasionally serious loss of human life. From one fire in Michigan in 1908 seventeen deaths were known to have resulted, and several more persons were badly injured. In that State alone during the fire season of 1908 not less than thirty-five people lost their lives as a direct result of forest fires.

Such fires could not occur in North Carolina, or only under very exceptional circumstances, because forest fires hardly ever burn through the tops of the trees, as they do in the spruce and pine forests of the

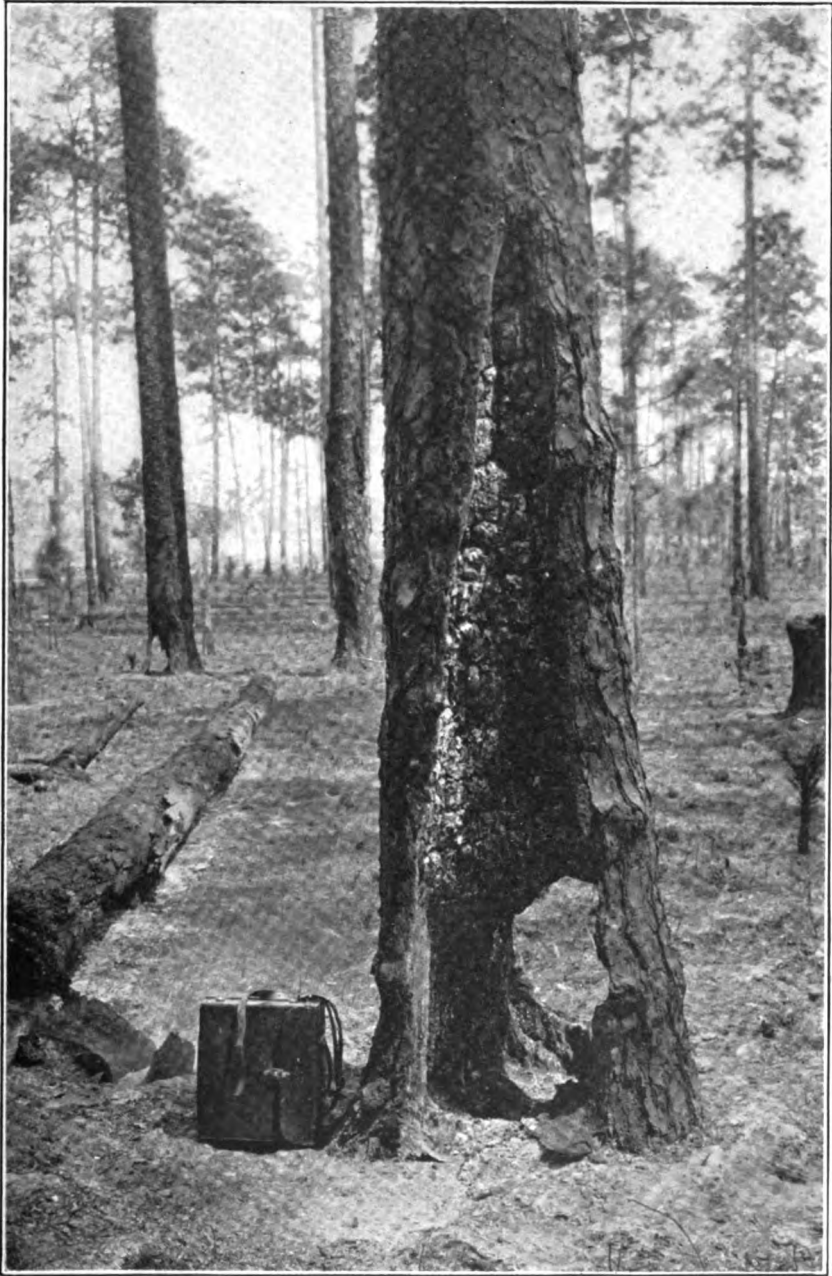


PLATE IV. HOW SURFACE FIRES DESTROY MATURE TIMBER. BASE OF PINE TREE BURNT THROUGH BY FIRE IN THE BOXES. THIS WILL BLOW DOWN, OR BE BURNT DOWN BY THE NEXT FIRE.

North. We are not, however, entirely free from this loss, for though no fatality, due to this cause, was reported for the year 1909, one death, caused by a forest fire, did occur in 1908. This was in one of the western Piedmont counties, where the forests are practically all hardwood.

Since these figures were compiled, news has been received of the sad death of a woman during the last days of March, 1910, in Cumberland County, who was killed while fighting a forest fire. Is it not time for the State and the people to get together and take some action toward checking this careless and wilful destruction of life and property?

AMOUNT SPENT IN FIGHTING FIRES.

By comparing the figures given under this heading in Table 1, it will be seen that only a small amount was estimated as spent for this purpose in the Piedmont region. It would appear that this is not entirely due to the smaller number of fires in this region, but partly to the method of estimating this cost. It is probable that most of the correspondents did not include the time of the farmer taken in fighting fires on his own land, but only counted such labor as was paid in cash by lumber companies or other large owners for this work. The figures given under the Mountain and Coastal regions tend to confirm this impression. In these regions about six times as much was spent for fighting fire as in the Piedmont section, probably chiefly because all the large forest holdings of lumber companies and others are in these two opposite sections of the State. Many of these companies pay out each year considerable sums to protect their properties from fire. But to obtain the true cost of fighting fires, there should also be added the time of the farmer who owns the small tract and of his family and neighbors spent in extinguishing fires and often in watching them, on and off, for days after the fire is under control. This often has to be done during the busiest season, when a man's time is worth two or three times what an extra man could be hired for at another time of the year. If this were included, the total cost would a long way exceed the \$13,564 given in the table.

But the cost of fighting fire should also be looked at from another point of view. It really is in many cases money spent to protect the unburned woods from the fire, and this should be its object in many more cases. Too often protection only goes as far as keeping the fire from fences, barns, piles of lumber, etc., without attempting to keep it from burning through the woods, when really the few dollars worth of fence that might be destroyed would not compare with the damage done by allowing fire to burn through the timber and young growth. Viewed in this light, the eleven million acres of forest land in North Carolina

cost a little over one-tenth of a cent per acre for protection in 1909. About 5 per cent of these forests were burned over, with a total loss of \$245,000, or about 62 cents per acre burnt, or over 3 cents per acre for the total forest area of the State. If more had been spent in fighting fires, there is no doubt that the total loss would have been very much less.

LOSS FROM FIRES THAT IS NOT COVERED BY QUESTIONS.

So far only direct losses have been considered, such losses as could be readily assessed by any average jury almost as soon as the fire was over. There is, however, another class of damages, none the less serious because they show themselves gradually, and can, as a rule, only be fully estimated by an expert familiar with the growth and habits of trees in the forest. These damages, though not at once apparent, are readily seen by any woodsman when pointed out to him.

TIMBER INJURED AND REDUCED IN VALUE.

In the great majority of instances, where fire burns through woods containing merchantable timber, comparatively little of this is killed or destroyed outright. For this reason it is frequently claimed that surface fires do not injure the merchantable trees. But every fire leaves its mark on these trees. A bunch of leaves gathering on the upper side of a tree, or a log or limb falling beside one, makes a dangerous point of attack, where the fire will be hotter than the delicate inner bark can stand. Wounds made by such burns form points of attack for insects and disease germs, where they may enter and gradually spread, often through the whole tree. Some species are much more easily injured by fire than others. It has been estimated that 75 per cent of the standing chestnut in the mountains of this State is unfitted for a good grade of lumber by worms and rot, and this diseased condition of the chestnut has been largely brought about by fires. With an estimated stand of something like three billion feet of chestnut in the mountain counties of the State, 75 per cent of which is reduced \$1 per thousand in value, which is a very moderate estimate, a total loss of \$2,250,000 has resulted to forest owners through injury to this one species alone. It may be contended that this damage has been accumulating for a long time, but should it be spread out over the last one hundred years, which is certainly much longer than is necessary to get this result, we get an annual damage to chestnut alone of \$22,500, which is practically half of the total value of timber destroyed outright by fire in that region in 1909. If the injury to the other timber, oak, poplar, hemlock, hickory, etc., which constitutes two-thirds of the stand in that region, be counted, it is



PLATE V. THE INCREASING NECESSITY FOR FIRE PROTECTION. OUR FUTURE HARDWOOD SUPPLY, SHOWING REPRODUCTION OF WHITE OAK, BUNCOMBE COUNTY, N. C. SURFACE FIRES WOULD ABSOLUTELY DESTROY OR VITALLY INJURE THESE YOUNG TREES.

U of M

Mr. U

pretty certain that the annual loss through injury to living timber will equal the loss to the forest owners through the destruction of timber from this cause.

INJURY TO YOUNG GROWTH AND REPRODUCTION.

The injury and destruction of standing timber is in most cases not the chief damage done to the forest by fire. Every fire running through the woods, even if only burning the leaves and grass, kills a great part of the seedling growth that should be carefully protected in order to insure a profitable forest growth in the future. All through the woods, especially when lumbering has let in more light and has torn up the ground, quantities of delicate seedlings of the tree species can be found. Yellow poplar and pine, our most valuable trees in the western and eastern parts of the State respectively, are very susceptible to fire when young, and are yearly killed by the million in the seedling size, by so-called harmless surface fires. Even the sprouts and suckers that form such a large proportion of the reproduction in the hardwood regions are easily killed by even light fires. This young growth is so often destroyed while very small, and so comparatively seldom attains its full development, that many people seem to forget its value.

For the future owners of the land the young growth, which is to take the place of the old timber when that is removed, or is already taking its place, has a very real and substantial value, and a value that can be estimated in dollars and cents. This may be seen more plainly from the following example, which is here simplified by the omission of complicated interest and other charges. A stand of second-growth pine forty years old was cut and yielded on an average 40 cords of pulpwood to the acre. This netted the owner a profit of \$1 per cord, after all expenses of cutting and marketing were paid. The value of this pine as it stood was therefore \$1 per cord or \$40 per acre. In cutting this stand a large lot of seed was scattered and the next year the area was covered with pine seedlings. As the ground was not wanted for agricultural purposes, the owner decided to raise another crop of pine on it. He would expect in forty years' time a yield as good as that which he cut off, and a price certainly not any lower. At the end of five years, however, fire got into this area and killed all the young pine. Here was a direct loss of \$5 per acre; for if the pine was worth \$40 per acre at the end of forty years, it was worth \$20 at the end of twenty years, or \$5 at the end of five years. But this \$5 was not the only loss, nor was it in this case the greatest loss. The old trees had all been removed from this area five years before, and after the first lot of reproduction was killed there were no trees to seed up the area again. So that this

land, which had been yielding the owner \$1 per acre every year in the growth of the pine, was yielding him nothing. Here, then, was a loss of \$1 per acre every year as long as he kept that land, or till he could, perhaps at considerable expense, put it to some other use. But suppose that there were seed-bearing pine trees around this area which would gradually seed it up to pine again. It might take ten years to get a stand dense enough to make a 40-cord crop, so that such a crop could not be expected for fifty years after the fire. There is then here not only the loss of \$5 per acre from the destruction of the young pines, but the postponement of the next crop ten additional years, or a loss of \$10 an acre in addition, or a total loss of \$15 per acre in the destruction of the young growth.

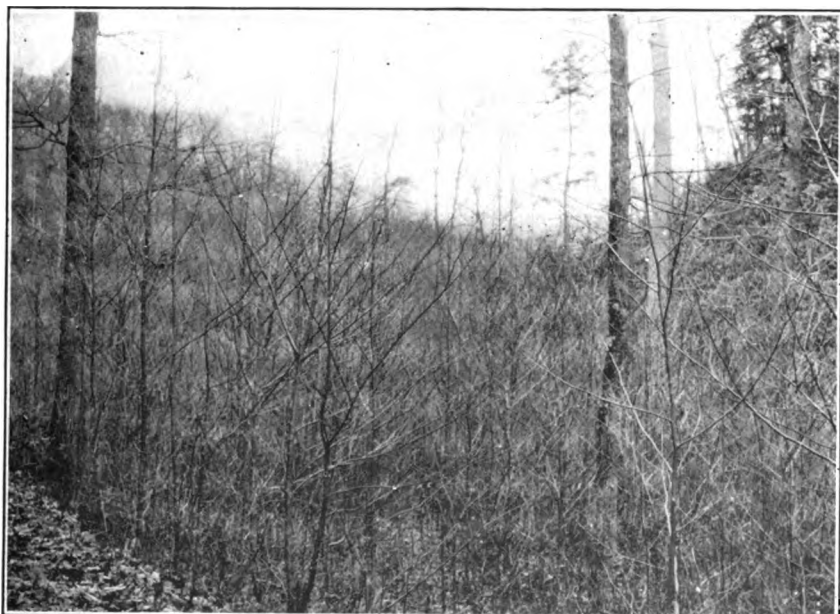
The foregoing is a very fair instance of the loss forest owners in nearly every county of the State are sustaining every year through the destruction of young trees, which is often entirely overlooked by the man who sees in a forest only its present value in timber which is now merchantable.

INJURY BY CHANGE IN COMPOSITION OF THE FOREST.

Frequent fires not only affect the temporary stand of reproduction, but also more or less permanently affect the composition of the forest. The young plants of some species are much more susceptible to fire than others, and the tendency is to reduce the proportion of the more easily killed species in the forest. Several of our most valuable trees are the most easily killed when young, and where fires are frequent these are rapidly disappearing from the forest. Yellow poplar is about the most valuable of the hardwood species and reproduces chiefly from seed. The seedlings of this tree are destroyed even by light fires, and unless these can be prevented, yellow poplar will gradually disappear from our forests. Many of the original stands of timber have contained 10 to 15 per cent of this species. Yet in a second-growth forest it is a rare thing to see as much as 1 or 2 per cent. Among hardwoods the poorer and less valuable trees are as a rule the most resistant to fire. The result of burning, then, is to increase the proportion of these less valuable species. Where fire is frequent our second-growth forests consist largely of the black oak, red maple, black gum, and other species that can better withstand fire. These trees, as is well known, only bring a comparatively low price when sold for timber, so that a forest consisting largely of these species would be worth much less than one in which the more valuable trees, such as yellow poplar, chestnut, linn, white or red oak, form an important part. Chestnut is also a tree that is easily injured by fire when young. In spite of its habit of sprouting from the stump, which often enables the young shoots to escape the worst part of the



A. HARDWOOD FOREST BURNT OVER AFTER LOGGING, WATAUGA COUNTY, N. C. ALL REPRODUCTION AND MOST OF THE SECOND GROWTH HAS BEEN KILLED.



B. HARDWOOD FOREST PROTECTED FROM FIRE. THIRTY YELLOW POPLAR REPRODUCTION, BUNCOMBE COUNTY, N. C. A FOREST FIRE WOULD DESTROY THIS GROWTH.

TWO WAYS OF TREATING A CUT-OVER FOREST.

1700

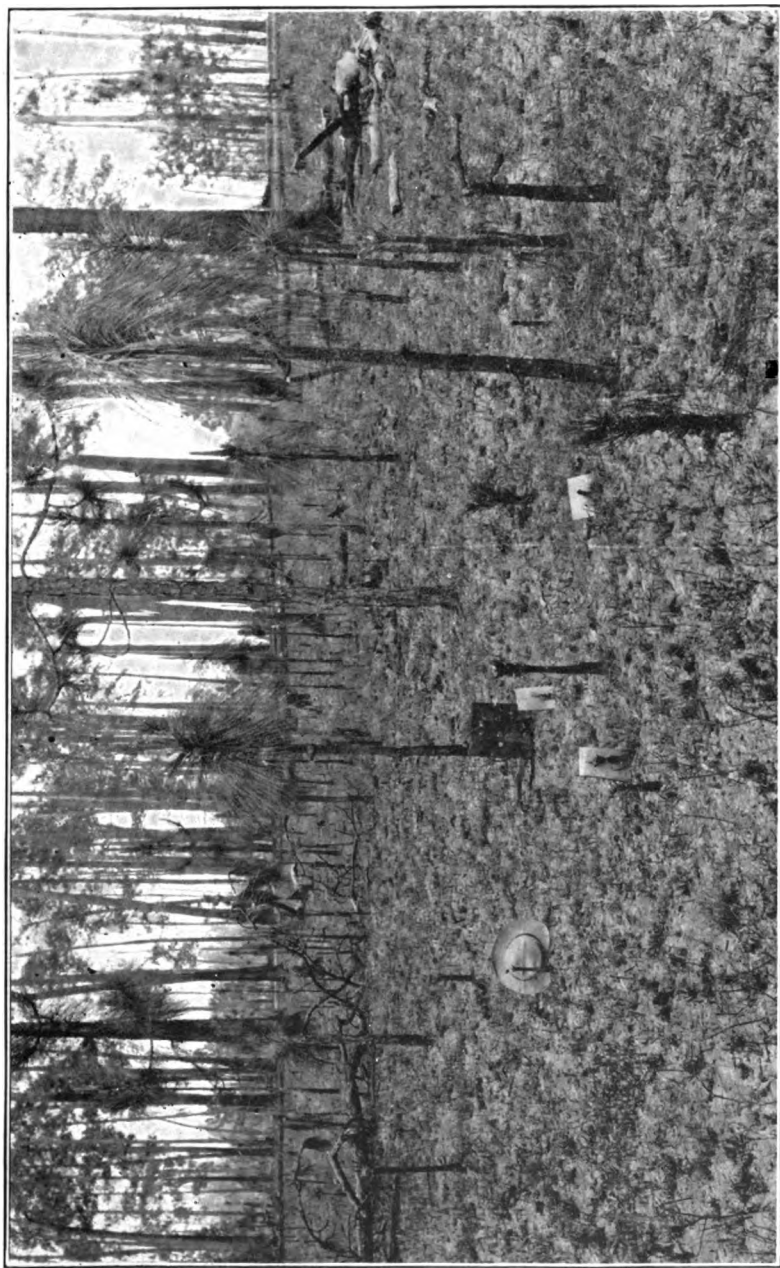


PLATE VII. LONGLEAF PINE FOREST. SEEDLINGS OF LONGLEAF PINE UP TO SIX YEARS OF AGE KILLED BY SURFACE FIRE.

100

fire, this tree is fast disappearing from the forests of the lower elevations, and there is no doubt that forest fires are to a large extent responsible.

The same is true to a certain extent of the pine forests of the Coastal region. All through the sandhill country where loblolly pine does not flourish, the original longleaf pine forests have been succeeded by areas of scrub oak, which are absolutely worthless for timber and are of little use even for firewood. It is commonly thought that this scrub oak growth is the natural successor of the longleaf pine after that is cut. This preponderance of oak is due largely, though not entirely, to the practice of burning. The oak is very resistant to fire and grows in spite of the burning, but the pine seedlings which have started and would have probably resulted in a second growth of pine are killed by fire. The result is that this land, which should be producing a valuable growth of pine, is now yielding absolutely nothing to the owner. The elimination of pine from this forest, like the reduction of the percentage of poplar and chestnut from the hardwood forests farther west, is in large measure due to fire.

IMPOVERISHMENT OF THE SOIL.

One of the most serious and universal losses through burning the woods is the gradual but certain impoverishment of the soil. Forest soils, if protected from fire, will not only maintain their fertility, but will increase in richness year by year. The more important food constituents of the soil, after being used by the tree, are returned to the soil by the falling leaves, practically none of the valuable elements being stored permanently in the wood. This process maintains indefinitely the fertility of the soil. When the leaves are burned, nitrogen, the most valuable part of the plant food, goes off in smoke and is entirely lost, while the potash and phosphoric acid are left in the ashes. These ingredients, however, are quite soluble in water, and the ashes being very light, the greater part of this material is carried off to the streams by the first heavy rain. Again, the rotting leaves and twigs form a covering of humus, which is the decaying vegetable matter which is so necessary for the growth of all plants. Without this humus the soil becomes hard and packed and the growth of the trees is very much retarded. The loss to the owner is felt in two ways: first, in the slower annual growth of the timber, and, second, in the reduced value of the land, should it be needed for agriculture. The timber should grow rapidly so that it will take as short a time as possible to mature. Should the owner, however, intend at some future time to bring this land into cultivation, he would want it to become as rich as possible. It has frequently been the custom to allow old fields to produce a crop of pine,

and when this is cut off, to again plant cotton or corn. This rotation of agricultural with timber crops can be worked very successfully if fire is kept out of the pine; but if constantly burned over, the land will be no richer, but even poorer, when the crop of pine is cut off, than it was when it was abandoned thirty to forty years previously.

SOIL EROSION.

After burning the leaves off the ground not only are the ashes washed away, but much of the surface soil is removed by the rain. As long as there is a good cover of forest trees this erosion will, as a rule, not extend beyond the surface soil. This surface, however, is generally the most valuable part of the soil, for it not only contains the ashes and decaying vegetable mould, but in it the mineral constituents are more available for plant food because of the direct action of frost and rain. When there is a good cover of leaves on the soil, the water sinks in instead of rushing off, and the loss from erosion is practically eliminated.

This loss from erosion through burning is perhaps even more apparent on cultivated slopes, above which are uncleared forest areas. If this forest land is burned over, the rain falling on it will run off rapidly onto the field below and will cause serious washing in the cultivated soil. If, however, the forest is not burned and a heavy covering of leaves, held together by twigs and brush, accumulates in the woods, the water will not gather above the field, and a great part of the erosion will be prevented. The loss from erosion to the farms of the Piedmont section of North Carolina alone during the wet spell in 1908 was estimated to have been half a million dollars. Much of this might have been prevented by protecting the forested slopes from fire.

INJURY TO STREAMS.

There has been much controversy recently as to the extent of the influence upon stream flow exerted by forests, and it is not proposed here to enter into this discussion. There are certain effects on streams, however, that every farmer and woodsman is familiar with. Every man who has built a fish pond will have noticed that the condition of the area which drains into the pond has a very marked effect on the condition of the water and the usefulness of the pond. If the pond is located in unburned woods, the water is nearly always clear and the pond will never fill up with sand or silt. If, on the other hand, the pond or the streams which feed it are surrounded by cultivated fields, the water will usually be muddy and the pond will readily fill up. This is caused by the surface soil from the fields washing down into the streams. If the slopes, though covered with forest, are kept free of

leaves and grass by frequent burning, silt will likewise be deposited to only a less degree than where the slopes are cultivated.

It is a well-known fact that springs surrounded by forests are much less susceptible to periods of drought and excessive rainfall than those in the open. The cover of forest leaves, by preventing the rapid run-off of rain, allows much more of the water that falls to sink into the soil. It is this soil water that eventually goes into the springs. If, however, the woods are burned, the water runs off almost as rapidly as it does from the open field, and much of the water that would otherwise feed the springs runs off at once in the streams, thereby increasing the amount of flood water. Though floods are not due to the removal of the forest, still there can be no doubt that their height and often destructiveness is increased by the removal of the forest, and also, to a very large extent, by the destruction of the leaf cover in the forest by fire.

CAUSES OF FOREST FIRES.

The study of the causes of forest fires is the most practical way of finding out the best method of preventing them. So that, though last in the list of inquiries sent to correspondents, this is one of the most important questions put before them. Out of the 156 correspondents who sent in replies only 94 answered this question. Some, however, gave two or three principal causes for the various fires in their locality. These causes are here tabulated according to the number of times they have been mentioned by the different correspondents and not according to the number of fires attributed to each cause.

TABLE 7.—FOREST FIRES IN NORTH CAROLINA IN 1909. CAUSES OF FIRES, BY FOREST REGIONS, AS GIVEN BY CORRESPONDENTS.

	Moun- tain.	Pied- mont.	Coastal.	State.	Percent- age.
Carelessness.....	6	6	3	15	10.8
Negligence.....	1	1		2	1.5
Farmers burning brush, etc.....	4	7	3	14	10.0
Hunters.....	6	8	9	23	16.0
Campers.....		3	1	4	3.0
Matches, cigar stumps, boys, etc.....	1	2	1	4	3.0
Railroad locomotives.....	3	6	14	23	16.0
Railroad section hands.....			2	2	1.5
Logging locomotives.....	1		5	6	4.3
Lumbermen.....			1	1	.7
Sawmills.....	2	3		5	3.5
Burning building.....		1		1	.7
To improve the range.....	4		1	5	3.5
Chestnut gatherers and root-diggers.....	2	1		3	2.0
Without much object, to see it burn, etc.....	15	2	1	18	13.0
Malice.....	4		1	5	3.5
Unknown causes.....	2	1	7	10	7.0

Of the various causes to which fires are attributed by correspondents, 100 answers can be classed as unintentional and 31 as intentional. The remaining 19 attributed forest fires to unknown causes.

UNINTENTIONAL CAUSES.

Practically all of the unintentional fires, except those caused by railroads, are due to the carelessness or negligence of the owner of the woodland or of some one who uses the land with or without his consent, so that the owner of the land is the man to take the initial steps to lessen the frequency of fires. Sixteen of the answers attributed forest fires to carelessness and negligence without specifying what form it takes, while most of them more specifically go to the root of the matter.

FARMERS BURNING BRUSH, ETC.

This report is written chiefly for the benefit of the farmers of the State, both because they own the greater part of the forest land of the State and because it is only through them that any permanent reform in the methods of handling our forests can be instituted. It is for this reason that the escaping of fire from farmers burning brush, grass, etc., is the most important of all the causes of unintentional forest fires, because the farmers themselves must begin by correcting their own carelessness, thus demonstrating their own good faith, in the campaign to prevent forest fires. These fires are very often not started by the owners of the land themselves, but by their renters, who have little or no land or other property of their own that can be damaged by fire.

Fires started in this way usually destroy more timber and do greater damage per acre in other ways than those occurring from any other cause, because they commonly occur in a dry time, usually in the spring, often after the sap has started to rise, and because they occur near the homestead or in a settled community, where often the woods have not been burned over for many years and where fences and buildings are endangered and are frequently destroyed.

In clearing up fence corners, briar patches, old fields, and other areas of grown-up or waste land, preparatory to putting in a crop, burning is too often resorted to. There is always very great risk of fire getting away in the dry windy spring days, and when it does, not only is tremendous damage done to fences and timber, but much loss of time is incurred fighting the fire, in the busiest time of the year.

Fire is used much too often in clearing up farm land. In nearly every instance the leaves, dead grass and other rubbish which are destroyed by the fire would add much to the quality of the soil if plowed under, and this could generally be done at little extra cost or trouble.

The little piles of briars, bushes, and roots that are usually burned could much more profitably be used in stopping washes or filling gullies. Vegetable matter should never be burned from the surface of land intended for crops, as all such material plowed in adds that much humus to the soil, thereby enriching it and greatly improving its physical condition.

HUNTERS.

By reference to the table it will be seen that the carelessness of hunters is thought to be the most frequent cause of fire in the Piedmont section of the State, and second in importance in both the other regions. This menace of the hunter is a very serious problem. The dangerous hunter usually is abroad at night, often walking miles from home. He builds a little fire in the woods while waiting for the dogs to "tree," and then goes off and leaves it burning; or he puts fire in a hollow tree to drive out a rabbit or a 'possum, and leaves it to burn out because he cannot easily extinguish it. Occasionally the day hunter sets out fire by the ignition of a gun-wad, or by throwing down a lighted match, or by leaving a fire by which he has warmed himself and eaten his lunch. It is very hard to find who are the hunters guilty of setting such fires, both because it is mostly done at night and because it is usually done far from any house. The hunter as a rule does not mean to set out fire, but in the excitement of the chase, or his desire to get home to bed, he does not take the trouble to see that the fire is put out.

This evil can best be combated by calling the attention of the hunter to the strong desire of the owner of the land to keep fires out, by putting up printed notices to that effect and by letting it be known in other ways. The law requiring a hunter to obtain the written consent of the owner of the land, which now only applies to certain counties, should be extended to the whole State. Such a permit system works no hardship to the legitimate hunter, but it helps him to realize that he is receiving a certain privilege from the owner of the land and that he should in return do his best to see that no injury results to the property through his being there. It has a tendency, also, to discourage the careless and irresponsible hunter who has no thought for the rights of his neighbors and does not want his presence on the property known.

CAMPERS.

The spread of forest fires from unextinguished camp-fires seems to be more frequent in the Piedmont than any other region of the State, though even here it is of secondary importance. Fires from this cause should in the future become less and less frequent, as with moderate care they can be pretty well controlled. In the first place, there is a strong law in

the State against leaving a camp-fire unextinguished. A man who does so is liable to a fine of \$50, whether any damage results from such fire or not. Again, camp-fires are nearly always made beside the road, where the passer-by can readily discover it, and easily trace up the one who lighted and left it. Again, camping is usually done in the summer, when the grass and weeds are green. At such times it is very hard or almost impossible to set fire to the woods. It is only in the autumn, after the leaves start to fall, or during a very dry spell in the late summer, that there is much risk from campers. By putting up printed notices along roads frequented by wagoners, near springs and other camping places, calling attention to the law relating to this subject, and by successfully prosecuting now and then one or two offenders against this law, the practice of leaving camp-fires burning could virtually be stopped and the annual damage from forest fires resulting from this practice would soon be practically eliminated. Camp-fires should never be built against large logs or dead standing or down trees, as after these get thoroughly started to burn it is almost impossible to extinguish them, and a fire readily spreads from a standing or down dead tree to the adjoining woods.

Fires lighted by men at work in or near the woods in cold weather, in order to warm their dinner or their hands, or just to light their pipes, are really a greater menace to the forests than genuine camp-fires. Though the man is probably somewhere about the fire all day, still after the sun gets warm or he gets interested in his work, he forgets all about the fire and it is very liable to get into the brush, or into a rotten or doty log, where it is very difficult or almost impossible to put it out. Such logs may smolder for days and then suddenly a fire break out, and the very man who set it will wonder how the fire started. The greatest care should be exercised in making any fires in the woods, and never should a fire be built against a rotten or doty log or standing dead tree.

MATCHES.

There is no doubt that many fires originate from the careless throwing away of matches, cigar or cigarette stubs, and from children playing with matches. In very dry weather it is exceedingly easy to set fire to a bunch of dry grass, and even leaves, by just throwing a match into it, and by the time the fire is visible the smoker has passed on. It is not hard to blow out a match, or to grind a cigarette stub into the ground with the foot—if one thinks of it. The forest rangers on the National Forests of the West make a practice of rubbing cigarette stubs out against trees or rocks before they throw them down; and in dry weather that practice would be advisable here. Children are often

accused of setting out fires in grass or leaves. It is, however, generally the parent's fault if children are careless with matches. If they are taught to be careful with fire, and are brought up to look on a forest fire as a calamity, there will be very few fires that can be attributed to their play.

The above causes of unintentional forest fires can be classed as individual, that is, they are caused by private individuals. These are very often persons without property or other responsibility, and so are the hardest class to appeal to for improved methods, or to control with the law, as they often have not enough property to make them legally responsible. Forty-one per cent of the answers given fall under the above head.

The remaining causes of unintentional forest fires can be grouped together as resulting from carelessness or negligence on the part of some business firm or corporation, mostly railroads and lumbermen. This class of fires may in the future be more readily controlled than those due to individual carelessness, for as soon as there is a more general demand from the landowners of the State for fire protection, the business men will soon recognize that their interest lies in acceding to that demand.

RAILROADS.

More correspondents attributed forest fires in this State to railroad locomotives than to any other one cause. It may be that the railroad gets the credit for some fires that originate from other causes, but it is certain that the indifference of railroad management, together with the carelessness of their employees, for which, of course, the railroads are responsible, is one of the chief menaces to our forests from fire. Under ordinary conditions sparks from the locomotives are small and fall on the railroad right of way. If this were kept free from brush and other inflammable material little harm would ensue. This, however, is not done; so fires very frequently start on the railroad's own property. The greatest danger is on stiff grades, where, with forced draft, large live sparks are often thrown out. In a high wind these may be carried for considerable distances, up to 100 or even 200 feet, often setting fire directly to the woods of the adjoining landowner. In places such as these, where the danger is greatest, the railroad and the owner should coöperate by clearing a wider strip clear of inflammable material. Fires frequently start from the burning of old ties or other rubbish by the section hands or by letting the fire escape when they are burning off the right of way. Some coöperative arrangement whereby the landowner would assist the section hands in burning off a strip two or three times the width of the right of way through forest land would be of mutual advantage, and

would practically prevent fires from these causes. It is strongly to the interest of the railroads to do all in their power to protect the forests from fire. These forests furnish the greater part of their freight in many counties, and by keeping out fire they would be greatly increasing their future freight tonnage.

LUMBERING.

The danger to the forests from fire due to logging operations is of the same sort as that due to railroads, but it is much more variable. Some lumbermen seem to do everything in their power to keep out fire, while others are absolutely indifferent to it. Of the seven correspondents attributing forest fires to logging engines and lumber hands, six were in the eastern part of the State. This is due in part to the fact that logging roads are more common in the Coastal Plain region, but it is also because the large lumbermen, in the western part of the State, are most anxious to keep out fire. One company in the mountains has standing orders for its log-train crew to stop the train to put out any fire that may have been started by the engine, and for any or all of its hands to drop what work they may be engaged in at any time to go and extinguish a fire. Another company in that region carries spark arresters in its engines. These are said to be quite efficient when in good order, but they need renewing quite often. Lumber companies when operating on their own land usually see the importance of protecting the forests from fire, while those logging on other people's land, having no future interest in the forest, do not usually take much trouble to keep fire out. In this case, it is more the fault of the owner, in neglecting to insist on proper fire protection when selling the timber, than it is that of the operating lumber company.

SAWMILLS.

Stationary steam sawmills usually necessitate an expensive plant, with large amounts of lumber stacked around, so that there is every inducement to protect these from fire. Portable sawmills, on the other hand, move from place to place, setting up right in the woods, cutting a small amount of lumber in a place and then moving on; the millmen sometimes owning the timber, but rarely owning the land on which the mill is set. It is these portable mills that, according to five of the correspondents, are responsible for fires in the Piedmont and western parts of the State, where this kind of mill chiefly flourishes. Several of the mountain counties have from fifteen to twenty-five such mills at work in them. In this case, again, it is the owner of the land as much or more than the millman, who is responsible, for he should stipulate that

every precaution against fire must be taken before he allows the saw-mill to come onto his land. There are quite efficient spark arresters that can be used on portable engines such as those used for sawmills, threshing machines, etc., and operatives should be compelled to use them. If the owner of the forest takes no precaution against fire, he cannot expect those using the land to do any better.

Forest fires resulting from all the foregoing causes, though unintentional, may be said to have been avoidable; that is, with proper care on the part of the people concerned, and watchfulness and foresight on the part of the owners, they should never have occurred. There are, however, accidental causes, such as lighting or catching from a burning building—which was the cause of one fire in the Piedmont region—that cannot be foreseen or guarded against any more than the loss of the building itself. Lightning is the cause of a great many forest fires in the semi-arid States of the West, but here in the East, where thunderstorms are rarely unaccompanied by rain, which will in most cases extinguish a fire if once started, fires from this cause are quite uncommon. Occasionally, a dead pine is struck and set on fire, and if not extinguished by the rain, a forest fire may result. These accidental fires, however, are not the ones we want to discuss. They are extremely rare and their occurrence is of more concern to the statistician than the economist. Preventable fires are what this study has to deal with, and by far the largest proportion of the fires fall under this class.

INTENTIONAL FIRES.

About 23 per cent of the answers give causes that can be classed as intentional, though in reality probably a much larger proportion of the forest fires occurring over the State are set on purpose. Many people do not think that a fire in the woods attains the rank of a forest fire if it is set for an object and destroys no standing timber. One of the chief causes of forest fires, especially in the Coastal Plain region, was never once mentioned by correspondents, probably because fires started for this purpose were not considered as forest fires. Protection fires are here referred to.

PROTECTION FIRES.

It is claimed by many farmers and other residents, especially of the eastern part of the State, that by burning off the dry leaves and grass during favorable weather, in the winter, when the fire can be kept more or less under control, much worse fires, coming perhaps in the dry spring months, and destroying much timber and other property, are prevented. This is a wrong principle to work on, though in certain cases, as a temporary expedient, its practice may be justified.

The present careless method of doing this, however, cannot be too strongly condemned. Section 3346 of the Laws of North Carolina expressly provides that no one shall set fire even to his own woods without first giving all adjoining landowners two days' written notice and also taking effectual care to extinguish such fire before it can leave his land. This law was passed because it was felt that it was needed, and it has remained on the statute-book for the same reason; and yet it is constantly disregarded, in fact, is very seldom fully carried out. Fires are set to protect fences and outbuildings and sometimes even dwelling-houses, to protect ties, shingles, cordwood, or other material remaining in the woods, to protect standing timber, and especially turpentine orchards.

In burning to protect fences, etc., only a narrow strip should be burned, confining the fire to a few furrows made with a plow, where possible. Care should be taken to prevent unnecessary burning around shingles, cordwood, etc. The practice of burning off a whole area where ties are going to be cut is most destructive. Ties are very often the last thing to be cut on an area, so that in working them up the forest should be left in the best possible condition for the future crop. Burning destroys or seriously injures the future crop.

Raking around the trees and burning when the woods are damp may be the best way to protect a turpentine orchard under present conditions, but if the timber is to be cut as soon as the crop is finished, very great risks are run of destroying, through burning, all the future usefulness of the forest. Longleaf pine produces seed to any considerable extent only every three to five years, and for that length of time before the trees are to be cut great care should be taken to preserve all seedlings that start. Burning and the hog destroy practically all of the longleaf pine reproduction.

Burning to protect standing timber is never advisable with the hardwoods. Even the little fires scorch the bark of the trees, doing great injury by letting in insect and fungus diseases. Most of the owners of hardwood timber in the State are now making earnest efforts to keep fire off their land altogether. Where unboxed pine timber is to be held for several years, some owners advocate burning for protection. There can be little doubt, however, that the loss from destruction of young growth, and the loss of growth in the timber itself, resulting from the impoverishment of the soil, will more than offset the immunity from serious fires.

"IMPROVING" THE RANGE.

Perhaps the most widely used excuse for burning the woods is the plea that it improves the range. It is claimed that by burning off the dead grass and leaves in the winter, the grass will start earlier in the

spring and the cattle will be able to get through the woods better to get at it; that if the woods are not burned they will grow up and gradually kill out the grass. This, in some cases, no doubt is true. But even though the early pasture may be made more available, the range as a whole is nearly always decidedly injured by burning. The better quality of grasses and most of the valuable native forage plants, such as the beggar lice and other peas, are discouraged or entirely killed out by the fires, and the soil, becoming poorer and poorer each year, cannot furnish as much forage as if it was not burned. The principle that all land should be put to its highest use should be borne in mind. If the land is more valuable for pasture, it should be cleared, so that as much and as good a pasture as possible could be made on that area. But, on the other hand, if the land is more valuable for forest growth than for anything else, the younger tree growth is what is wanted and every effort should be made to encourage it.

CHESTNUT GATHERERS.

The woods, especially in the western part of the State, are frequently burned by chestnut gatherers, root diggers and mineral hunters. As the leaves and the fruit of the chestnut fall about the same time, fires are often set to clear the ground so that the chestnuts can readily be seen and picked up. In the same way the woods are occasionally burnt off in the winter and spring, so that the first spring leaves of the ginseng or other marketable herbs can easily be found. Mineral hunters, also, sometimes burn off the woods so that the surface indications can be seen by just walking over the ground. Burning for these causes is nearly always done on lands belonging to some one else, by irresponsible people with little or no land of their own. Such burning comes clearly within the scope of section 3346 of the Revisal, making those who set such fires subject to a heavy fine as well as to damages. The great difficulty, of course, is to secure sufficient evidence to convict before a jury that is indifferent to forest fires. This drawback will gradually right itself with the awakening of public opinion, and as the amount of money made in these ways becomes less and less, and the number of people following these vocations diminish, the number of fires from these causes will gradually decrease.

NO PARTICULAR REASON.

There seems to be born with the backwoodsman an inherent desire to burn the woods. The early settlers looked upon the forest as an enemy; something to be conquered and destroyed as rapidly as possible. Many of the present generation seem to have grown up with the same idea. The most trivial excuses are often given for setting fire to the forest,

as, for instance, the killing of snakes or ticks. As the snakes and the ticks are in the ground when the burning is usually done, and so are not hurt by the burning of the leaves, this seems a childish excuse. It is also pleaded that if the woods are not burnt now and then they will get too dense to walk through with comfort—as if the chief object of keeping woodland and paying taxes on it was to have an open place to walk in! The denser the undergrowth, the better the timber will be, and the more young growth there is to take the place of the old timber, the greater will be the future and also the present value of the forest.

About half the correspondents in the mountain counties who referred to the causes of forest fires gave it as their opinion that fires were chiefly set by the loafing, irresponsible class, by men who have no property and little interest in the advancement and prosperity of their community. A few quotations from these correspondents will give an idea of what kind of people set out forest fires, and how they are thought of in their own community. In answer to the question "What are the causes of forest fires?" the following replies were given:

"People passing along and setting it on fire";
"Done more to see it burn than anything else";
"Men who own no forests set them out";
"Set out by lawless citizens";
"Just to see the leaves burn";
"Fire set privately in the woods";
"Done by men who do not care for the damage it does";
"Fired by careless boys, generally";
"Incendiary people who want to destroy";
"Stragglers setting fire to the leaves";
"Trifling, careless men setting it secretly";
"Set out by thoughtless and careless persons who seem not to care what the result will be";
"Set out by men hunting and loafing around in the woods."

Such comments as these indicate a distinct and intelligent sentiment against burning the woods. This is the ruling feeling in the better settled counties, and even in the rougher regions the great majority of the landowners deprecate the frequency of forest fires. All of which seems to indicate that we are at the dawn of an era of forest protection in this State.

MALICE.

So far only accidental fires, chiefly those due to carelessness and negligence, have been dealt with, and intentional fires set by persons ignorant of or at least indifferent to the injury that would result to the landowner. There are, however, unfortunately, some fires set each year for the express purpose of injuring some one. Four correspondents in

the mountain counties and one in the Coastal region attributed forest fires in their counties to malice. Setting fire to and destroying a man's crop of pine poles or locust posts or other forest crop is just as felonious as burning his hay or oat crop, and should receive just as severe punishment; and setting fire to the leaves or grass on purpose to burn a man's fence is exactly the same kind of crime as setting fire to a straw stack on purpose to burn his barn.

In trying to "get even" with some company or owner of forest land, or with some one employed by them, by injuring or destroying their forest property, a man really injures himself and his community a great deal more than he does the owner of the timber, even looking at it merely from a material point of view. That is, the owner loses only the value of the timber as it stands and the net profit that he would make on manufacturing it, while the community would lose all the money that should be paid out to local men manufacturing this timber from the tree into the finished product. A single example will bring out the point more clearly. The Forester to the North Carolina Geological and Economic Survey, after spending several days in the mountains of Graham County last summer, estimated that at least five million feet of timber had been destroyed by fire in that county in the past five years. This timber would have been worth from \$1 to \$3 per thousand as it stood, or a total value to the owners of about \$10,000. If this timber had not been destroyed it would in the regular course of events have been cut, manufactured and sold within a few years' time at approximately the following cost: Cutting and logging to the mill, \$6 per 1,000 feet; sawing and stacking, \$3 per 1,000; hauling to railroad and loading on cars, \$1 to \$11 per 1,000, or at a total cost of from \$10 to \$20 per 1,000. Practically all of this money would have been paid out to local residents and circulated through the neighborhood; so that the community suffered a loss of from \$50,000 to \$100,000 through the destruction of this \$10,000 worth of timber belonging to other parties. If it were more generally recognized that the burning of the woods involved not only an individual loss to the owner, but a really much greater money loss to the community, more care would be taken to prevent fires, and greater efforts would be made to apprehend and punish the miscreants who intentionally set fire to the woods.

UNKNOWN CAUSES.

It is quite remarkable how few correspondents attributed forest fires to unknown causes. This seems to show that, when fires occur, people have a pretty good idea of how they are started and who sets them—enough to satisfy themselves in their own minds, though sufficient evi-

dence may not be available to prove a case before the courts. It seems evident, therefore, that as the feeling against burning grows stronger, and the average jury becomes anxious to punish such lawbreakers, it will not be found so difficult to apprehend and convict the incendiaries as many people are now quite prone to think.

PREVENTION OF FOREST FIRES.

It is generally admitted by the most enlightened and progressive people of this State that forest fires are very destructive, and are a great misfortune to the community. Many men, however, without seriously thinking of the question or making any effort to improve these conditions, claim that the common practice of burning the woods cannot be prevented. Yet all experience goes to prove that damage by forest fires is practically preventable. In Europe, where burning a man's woods is looked upon in the same light as burning his barn or his house, the one is almost as rare as the other. In the forests of Prussia, for example, with an area of approximately two-thirds that of the North Carolina forests, during a period of thirty years only one-fiftieth of one per cent was burned each year. This was not due to a difference in the nature of the forest, since much of the area was dry sandy pine land quite similar to our own eastern forests. How does this compare with the 5 per cent or more burned over in the forests of North Carolina? It is quite true that if no measures are taken to prevent fires, we cannot do much to improve the present conditions; but there is no doubt that fire protection is practicable and can be effective as soon as we come to the conclusion that it will pay.

PUBLIC OPINION.

The first and most important thing that must be done toward preventing this annual loss from fire is to bring about a change in public opinion. As soon as the mass of timber owners and timber users of the State are persuaded that fire protection is desirable and practicable, then and then only will protective measures succeed. This is a work that every one can help in by practicing and preaching fire protection. A few men can get together and get laws introduced and passed by the Legislature, but these laws (though good in themselves) will have little effect unless public opinion is behind them. What is needed in North Carolina more than anything else is a strong sentiment against fire in the woods. This sentiment is found to be quite strong in many of the better settled counties, and it is gradually spreading over the rest of the State. When people realize that it is their pocket that is being affected, they will make greater efforts to protect their property.



A. EFFECT OF BOXING AND FIRE. PINE FORESTS LAID WASTE IN COASTAL PLAIN REGION.



B. FIRE PREVENTION. ROAD USED AS A FIRE-BREAK WITH COMPLETE SUCCESS IN A LONG-

STOCK LAW.

As we have previously seen, one of the most fertile and widespread causes of fire is the practice of ranging the cattle in the open woods. At present there are large areas in the mountain counties of the State on which all kinds of stock are allowed to run at large. Practically two-thirds of the Coastal Plain region is also outside of the operation of the stock law. This fact greatly increases the number of fires in these two regions, and is one of the chief causes of the great difference in the number of fires, as seen in Table 1.

As some people may not understand what is meant by the stock law, a brief description of its workings is here given. The stock law is a local-option measure which, by a majority vote, any county or part of a county may make applicable to itself. Where the stock law is not enforced, cattle, hogs, and other domestic animals are allowed to range through the woods at will, whether the owner of the stock has any land or not. This compels every farmer to put a fence around his crop to keep his neighbors' stock from destroying it. With the introduction of the stock law, however, the owner has to fence his own stock and is responsible if it wanders onto his neighbors' land, so that only pastures need be fenced, and cultivated land is usually unfenced. This system is certainly better for a well-settled community. Even for a thinly settled region, the open range can only be justified on the ground that the ranging of stock does no injury to the owner of the land, as one of the first principles of law is that a man must be protected in his property. One of the chief deterrents to the introduction of the stock law now is the fact that a new district coming under its jurisdiction has to fence itself against the surrounding region in which stock run at large. This is unjust and an imposition, for the people who benefit by the open range should be willing to keep their stock from bothering those who do not want it. A much better plan would be to compel all counties that do not want to come within the benefits of the stock law to fence themselves, and so keep their stock from wandering upon the surrounding district, and the law should be changed in this way. A still better way would be for the people of the east and the people of the west to decide that they have had enough forest fires, and go to the next Legislature and demand that the stock law be extended to the whole State by enactment of the Assembly.

By treating the forests as other private property and preventing stock from running at large in the woods, a great stride will be made toward the prevention of fires in those regions. A man who runs his own stock in his own woods will not, as a rule, burn those woods, because he realizes

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that the injury done to the forest is immensely greater than the benefit to the range from burning. There is no more reason why a man should submit to having his woods burned for the benefit of his neighbors' cattle than there is that he should have his corn crop ruined to feed his neighbors' hogs. It is generally admitted that no attempt can be made to control the Texas cattle fever or eradicate the fever tick till the county or community passes a stock law. In the same way the introduction of the stock law should be the first step in fire prevention.

FIRE LAWS.

North Carolina has two excellent laws against burning the woods, though this fact seems to be very generally lost sight of by the majority of people. If these two laws were strongly enforced, a very great deal could be accomplished in the prevention of fires. There are, however, certain laws which are working very well in several other States that would help very materially in the work of fire prevention. Perhaps the most important law, and the one that North Carolina needs most, is a local-option measure which will permit any county or township to employ a man for the special purpose of preventing and extinguishing forest fires in his county or district. Such a man, often called a fire warden, would patrol the wooded regions of the county during dry weather, and if a fire was discovered would be empowered to summon necessary aid to extinguish it. He would investigate the causes of fires, and bring to justice those responsible for them. His remuneration should come partly from the township or county employing him, and partly from the State. One or more energetic men in each county would do more in preventing fires than a dozen men could do by waiting till fires start and then trying to extinguish them.

Another law which has worked well in States similar to our own compels farmers and others to notify such a warden or other county authority when he wishes to burn brush or grass during exceptionally dry weather. As we have seen before, a great portion of our most serious fires are caused by the burning of brush in the dry spring weather by irresponsible people. This law would in large measure do away with such fires. All laws, however, must be backed by public opinion to be most effective; so that the first and most important thing to do is to educate public opinion.

RAILROADS.

The railroads of the State are responsible for a great many of the forest fires. They seem to lose sight of the fact that by protecting forests along their lines they would be adding to their future business by increasing the supply of available timber. In other States the railroads

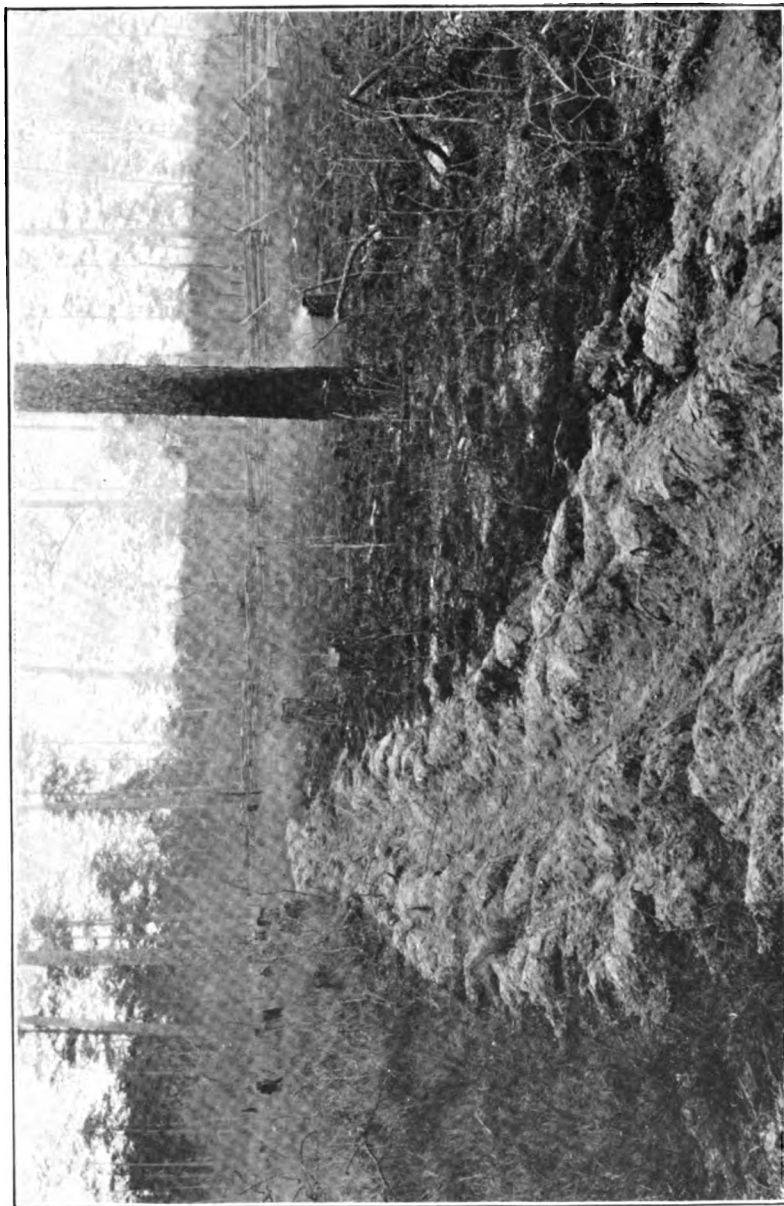


PLATE IX. FIGHTING FIRE WITH THE PLOW. SURFACE FIRE IN PINE FOREST STOPPED BY PLOWING TWO DOUBLE FURROWS.

॥१०॥

have done little or nothing to prevent the spread of fires from their lines until compelled to do so by law. Such negligence on their part in North Carolina will compel the State to pass laws obliging them to do their part toward protecting the forests along their lines from fire. Many States oblige the companies to keep efficient spark arresters in all of their locomotives. Some of the lumber companies in this State have introduced spark arresters with very considerable success, thus adding very much to the security of their own property from fires. The public railroads of the State should do the same. Most railroads keep their right of way cut off for a short distance on each side of the track, but this area should be kept clear of all inflammable material. By coöperative arrangement with adjoining owners, a strip two or three times the width of the right of way might be kept clear, thus adding tremendously to the effectiveness of any protective measure. Such arrangement, however, would not be entirely a matter of law, but would also depend on the willingness of the owner to coöperate with the company. During dry seasons the railroads should patrol their lines to extinguish any fires that might be started from the locomotives, but this again could be made much more effectual and be done much more thoroughly if some coöperative arrangement with adjoining owners could be made. Such coöperative agreements have been very successfully carried out in several of the States, and the management of the National forests of the West have effected similar arrangements with some railroads. The railroads, however, cannot be expected to carry out an expensive protective policy unless the adjoining owners show some interest in the work and are willing to coöperate with the railroads in any way that they can.

FIRE PROTECTION.

Besides these general educational and legislative measures, much can be done to protect the property of the individual from fire. For the lumber company or other forest owner who desires to protect his own property from fire, three very important measures are recommended: (1) The construction of fire lines; (2) the employment of patrols; and (3) the posting of notices.

FIRE LINES.

Fire lines are lines of more or less open area, cleared of grass and leaves and other inflammable material. Such lines may be roads, trails, streams, etc., where fires may be stopped or from which back fires may be started. Many forest tracts in the mountains have their principal boundaries on the tops of ridges or along streams. In such cases it is easy to work out lines that will stop ordinary ground fires. A trail 3 feet wide along a ridge will generally stop a fire, as fires do not readily start downhill.

Logging roads and wagon roads kept clear of leaves will, under ordinary circumstances, stop even a heavy fire. By using such natural fire lines and by making some where these are wanting, a system of fire lines sufficient to make the average timber tract comparatively safe from fires can be constructed at very moderate cost. A fire line 10 or 12 feet wide can be chopped and grubbed out in the hardwood regions of the State for from \$10 to \$15 a mile. In the more level Coastal regions fire lines can be constructed quite cheaply by plowing two parallel strips 3 or 4 feet wide from 50 to 100 feet apart and carefully burning off the enclosed area at a time when there is little risk of the fire spreading. Such a fire line, when once made, costs little to open out each year. It has been found, however, in practice that the intermediate ground will not always burn off readily every year, as in the poorer sandhill country sufficient grass and leaves will not accumulate in one season for this purpose. Under such conditions, a third strip would be plowed on one side or the other of the line plowed the previous year, thus making two protected strips, one of which can then be burned off every alternate year. With such fire lines around a forest property, and a few others dividing the area up into compartments so that should a fire originate on the property itself it could be stopped by an interior fire line, quite effective protection can be secured.

FIRE PATROL.

The one thing that has contributed most towards the success of fire prevention on the National forests and on State lands in the East has been a system of patrol. Men employed to patrol a property during dry seasons are ready to extinguish any fires that may be set, and thus prevent small fires becoming large and unmanageable ones. The success of patrol, however, consists still more in fire prevention. If it is generally known that men are watching a property, hunters and loafers and other dangerous persons are liable to be very careful, so that much fewer fires originate than if no one were watching the tract. Some forest properties, even in North Carolina, have patrols employed regularly the year round, though in wet seasons and at other times when there is little danger from fire, these men may be employed in road building, surveying, or other work connected with the property. It has been found that even in regions where burning is the common practice, such patrol has in a large measure prevented serious fires.

FIRE NOTICES.

The posting of warning notices along trails or other places where people pass, on the main roads, and at public meeting places is a very

important part of fire protection and has been practiced with much success both on the National and State forests, and also in many cases on private forest properties. A notice will generally attract the attention of the passerby, and, if it is short and in good type, will generally be read by him. Such a notice is calculated to make a man more careful when he would otherwise not think of the danger from fire. The majority of fires in this State result from carelessness and not from malice. If, therefore, a notice is read, reminding the passerby of the danger of fire and the injury resulting from it, in many cases the fire would be prevented. Notices may be of several kinds, to deal with the several different classes of people, and where one landowner would find one kind efficient, another owner in another locality might find a different kind of more use.

Where the owner resides on the property and is on good terms with the neighbors, a gentle reminder will often be much more efficacious than a legal warning. The following notice is suggested:

NOTICE!

THE OWNERS OF THIS LAND ARE VERY ANXIOUS TO KEEP

FIRE

OUT OF THE WOODS AT ALL SEASONS OF THE YEAR. THEY ARE, THEREFORE, ASKING THE ACTIVE CO-OPERATION OF ALL NEIGHBORS WHO ADJOIN THIS PROPERTY AND ALL PERSONS WHO PASS OVER OR USE THIS LAND FOR ANY PURPOSE WHATSOEVER. SUCH PERSONS ARE REQUESTED TO BE VERY CAREFUL ABOUT THROWING DOWN LIGHTED MATCHES, CIGAR OR CIGARETTE STUMPS OR ASHES FROM THEIR PIPES; TO MAKE NO CAMP-FIRES AGAINST LARGE LOGS OR DEAD STANDING OR DOWN TREES; TO BE VERY CAREFUL TO EXTINGUISH ALL CAMP-FIRES BEFORE LEAVING THEM; AND TO DO THEIR BEST TO EXTINGUISH ANY FOREST FIRE THAT THEY MAY DISCOVER.

If, on the other hand, the people of the neighborhood do not understand the reasons for fire protection, and it is thought that they are not conversant with the laws on this subject, a fire notice like the following may have the most effect:

LOOK OUT FOR FOREST

FIRE

DO NOT BURN THE WOODS. IT CAUSES THE DESTRUCTION OF MUCH TIMBER, ESPECIALLY YOUNG TIMBER, AS WELL AS OTHER PROPERTY.

LAWS OF STATE OF NORTH CAROLINA (Section 3346 of Revisal).

If any person shall set fire to any woods, except it be his own property, or, in that case, without first giving notice in writing to all persons owning land adjoining to the woodland intended to be fired at least two days before the time of firing such woods, and also taking effectual care to extinguish such fire before it shall reach any public or private lands near to or adjoining the land so fired, he shall for every such offense forfeit and pay to any person who shall sue for the same fifty dollars and be liable to any one injured in an action, and shall, moreover, be guilty of a misdemeanor.

If, again, there is a certain lawless element in the neighborhood, and it is thought that fires are being set on purpose, a sharply worded warning to the effect that the owner was on the lookout and would prosecute any one caught setting fire, to the full extent of the law, might be the best form of notice.

A clause against burning the woods should in all cases be combined with the ordinary form of trespass notice which is now coming into such common use. It is certainly as important to warn trespassers against setting fires as it is to forbid them to camp or to range stock. A trespass notice might read somewhat as follows:

NOTICE!

ALL PERSONS ARE HEREBY FORBIDDEN TO TRESPASS ON THIS LAND, EITHER BY HUNTING, FISHING, CUTTING TIMBER, FIRING THE WOODS, CAMPING OR RANGING STOCK OF ANY KIND, UNDER PENALTY OF THE LAW.

[SIGNED] JOHN DOE.

Any of the above notices can be printed on heavy cloth by local printers at prices ranging from 65 cents a dozen and \$2.50 a hundred to twice that price. The most convenient sizes are 9 x 12 inches or 12 x 18 inches.

EXTINGUISHING FIRES.

Most people who live in or near the woods have some idea of how to fight a fire, but a few suggestions may be helpful to some readers. When no wind is blowing, an ordinary grass or leaf fire can generally be extinguished by beating with green brush, pine tops, laurel, or ivy bushes, canes, or other tough and dense brush, or with a wet sack. If, however, the wind is blowing, such a fire cannot be attacked directly in front. The best way is to work on the rear and side lines of the fire and gradually, as opportunity offers, crowd it in, so that the front gets gradually narrower and narrower. Then, by taking advantage of any change in the wind, or of a stream or ridge top, the front of the fire may finally be stopped. The best time to fight a fire is at night, when the wind is less likely to be blowing and when the leaves get somewhat damp with dew. Where a fire is too hot to get to it to beat it out, the leaves can be raked away from it, so that a fire line is really made in front of the fire at which the fire will naturally stop when it finds no more to feed on. In fairly level country, as in the pine region of the East, good work against a fire can often be done with a plow, one furrow frequently being sufficient to stop a ground fire when there is not much wind. Where a wagon can drive through the woods and get close to the fire, chemical extinguishers have been used to good advantage, the contents of one extinguisher effectually putting out from 50 to 100 yards of fire. In the northern forests a hose from a train or a pump on a wagon has been used very successfully, and this method could probably be used to good advantage in this State by railroads and the larger lumber companies. In some cases when fires get beyond control and there is no chance of a fighting force getting near enough to put it out, back firing has to be resorted to. This means setting a fire in front of an advancing fire and allowing it to burn back against the wind and towards the large fire, without letting it advance with the wind. Such a method should be resorted to only in exceptional cases, when no other method seems available, and it should be done with the greatest care, for a back fire getting beyond control only adds to the destructiveness of the original fire.

The principal thing in extinguishing fires is to begin at once. A small fire is easily controlled and quickly put out, but a few hours' delay may mean a large, unmanageable fire which will destroy much property and cost a lot of time and money before it can be brought under control.

CONCLUSION.

According to 158 correspondents, reporting from 84 counties of the State, something over 400,000 acres of forest land were burned over in North Carolina during the year 1909. It is estimated that, with counties not heard from, many townships entirely unreported, and fires overlooked by correspondents, this total should be increased by at least 50 per cent. At this rate, over 5 per cent of the estimated total area of forest land in North Carolina was burned over in 1909.

The damage, as estimated by correspondents, amounted to over \$260,000, or about 66 cents per acre burned. This direct loss of 66 cents does not include damage to living timber, to young growth, to soil and streams, which certainly amounts to more than as much again. This loss of \$1 to \$1.30 per acre is in large part preventable. Forest fires are caused chiefly by carelessness, less than 25 per cent of the correspondents attributing them to incendiary origin. To overcome this careless attitude on the part of the people, and induce both private effort and State coöperation in the fight against forest fires, public opinion on this subject must be awakened. With the general application of the stock law over the State, the passage of some progressive laws by the Legislature, and the hearty coöperation of the counties and townships and of the railroads, supported by a strong public sentiment against fire, this loss of from one-half to three-quarters of a million dollars a year to our people from forest fires will rapidly be reduced to a minimum.

PUBLICATIONS
OF THE
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*
11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
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15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade Trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*

18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents.*

19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*

20. Water-powers of North Carolina: An Appendix to Bulletin 8. *In Press.*

21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*

22. A Report on the Old Mining District, by J. E. Pogue, Jr. *In Press.*

ECONOMIC PAPERS.

1. The Maple-Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a List of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virgillina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestone; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos, and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial

Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including Classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.

15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

19. Forest Fires in North Carolina During 1909, by J. S. Holmes, Forester, 1910. 8°, 52 pp., pl. *Postage 3 cents.*

VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. The Physiography and Geography of the Coastal Plain Region of North Carolina. *In Press.*

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that **NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE.** Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

ECONOMIC PAPER No. 20

WOOD-USING INDUSTRIES OF NORTH CAROLINA

BY

ROGER E. SIMMONS

UNDER THE DIRECTION OF

J. S. HOLMES AND H. S. SACKETT



RALEIGH

R. M. UZZELL & CO., STATE PRINTERS AND BINDERS

1910

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LETTER OF TRANSMITTAL.

CHAPEL HILL, N. C., July 1, 1910.

To His Excellency, HON. W. W. KITCHIN,
Governor of North Carolina.

SIR:—There has just been prepared a report on the Wood-using Industries of North Carolina, which has been compiled by Mr. Roger E. Simmons. This report has been prepared jointly by the North Carolina Geological and Economic Survey and the U. S. Forest Service, and I would recommend that this be published as Economic Paper No. 20 of the reports of the Survey. This report should be of considerable value to the State of North Carolina in forming a forest policy which, if worked out along certain lines, will insure a permanent supply of raw material for our wood-using industries. The report will also be of interest and value to the timber owner, the sawmill operator, and the manufacturers and merchants who handle the finished products.

Yours respectfully,

JOSEPH HYDE PRATT,
State Geologist.

CONTENTS.

	PAGE.
Introductory statement by Joseph Hyde Pratt, State Geologist.....	7
Wood-using industries of North Carolina.....	11
Introduction	11
Kinds of woods used.....	11
Home-grown woods used in North Carolina.....	13
Woods grown outside of North Carolina.....	15
Industries utilizing wood.....	17
Consumption by industries in regions.....	20
Form, grade, and sizes of raw material.....	22
Flooring, ceiling, siding, etc.....	25
Furniture	27
Boxes and crates.....	30
Sash, doors, blinds, etc.....	32
Chairs	34
Tables	36
Vehicles	38
Fruit and vegetable packages.....	40
Insulator pins and brackets.....	42
Coffins, caskets, and casket cases.....	42
Handles	44
Shuttles, spools, bobbins, etc.....	44
Farming implements	45
Kitchen safes	46
Cross-arms	46
Pipes, mine rollers, and pulleys.....	47
Store and office fixtures, mantels, etc.....	48
Musical instruments	50
Planking for boats.....	52
Excelsior	52
Woodenware	53
APPENDIX I:	
Uses of different kinds of woods (list).....	55
APPENDIX II:	
List of wood manufacturers.....	61

LIST OF ILLUSTRATIONS.

PLATE	<i>Facing Page</i>
I. Bird's-eye view of the furniture district of High Point, N. C. "The Grand Rapids of the South".....	11
II. Mill and yard of Goldsboro Lumber Company, Dover, N. C., manufacturers of high-class flooring, ceiling, siding and molding. The pine logs in the foreground are ready to be sawed.....	22
III. Main floor of the factory of the Southern Chair Company, High Point, N. C.	28
IV. Turning-room of Southern Chair Company, High Point, N. C.....	34
V. A, Interior view of wheel factory of High Point Buggy Company, High Point, N. C. B, Interior view of packing department of High Point Buggy Company, High Point, N. C.....	38
VI. Mill and yard of the Wilkes Veneer Company, Edenton, N. C.....	40

INTRODUCTORY STATEMENT.

By JOSEPH HYDE PRATT, STATE GEOLOGIST.

The present report deals with the wood-using industries of North Carolina. These may be divided into three classes: (1) those taking timber in the log and by the usual operation of the sawmill converting it into rough lumber; (2) those manufacturing directly from the log a finished product which cannot be changed by any further process of manufacture, such as staves, excelsior, shingles, veneer boxes, or mine rollers; and (3) those using rough lumber and by application of skilled labor and the aid of wood-using machinery converting it into such finished products as furniture, boxes, flooring, etc.

The wood-using industries which come under the first class are not included in this study. Information covering that class is published annually in a statistical report by the Bureau of Census in coöperation with the United States Forest Service, which gives the lumber cut for the country by States and species. The second and third classes, or those industries producing a commodity which cannot be changed by further manufacture, are discussed in this report, and information regarding them has been collected from all sources available. This information has never, heretofore, been made a subject of special investigation in North Carolina. The new forms which further manufacture gives to lumber, and the commodities into which wood enters, are worthy of careful study. The tables given in this report show the sources of such wood used, whether grown in North Carolina or in States nearby or far distant, the kinds of lumber demanded by the woodworking factories, the price paid for each species delivered, the quantity consumed, and the purposes for which it was used.

An investigation of this character should be of value in a number of ways. To the State of North Carolina it should be of considerable assistance in forming an intelligent forest policy, and in presenting the advantages the State offers to wood-using industries to locate in it. The timber owner, and even the farmer who has a few scattered trees to sell, can learn from this report where a market can be found. To the sawmill operator it may suggest a use for wood which he previously considered of little commercial value. To the manufacturer who is under the necessity of looking beyond his own State for all, or part, of the lumber needed, it will furnish a source of fairly accurate information concerning a region most likely to supply his needs. The merchants throughout the country who handle wood products can study to advan-

tage the report of what North Carolina has to sell, or wishes to buy. For the people at large it has a statistical value, and gives much general information.

It gives valuable information concerning the forms, uses, and grades in which the factories desire the lumber, and also the woods most suitable for particular purposes. The chief purposes of this report are to give needed information regarding these industries, to stimulate trade by bringing together buyer and seller, and to show the citizens of North Carolina the wisdom of perpetuating her valuable wood-using industries by the adoption of an intelligent forest policy. Two appendices have been added to this report. The first gives a list of the different kinds of woods that are found in North Carolina, together with the various purposes for which they are used, and the second appendix gives a list of the wood manufacturers of North Carolina under the heads of the products which they manufacture.

The information contained in this report was gathered in the fall of 1909 by the Forest Service of the United States Department of Agriculture and the Forestry Division of the North Carolina Geological and Economic Survey, and these two departments desire to express their thanks to the manufacturers supplying this information, and especially to those who have answered requests for information by mail. The report has been compiled by Mr. Roger E. Simmons, under the supervision of Mr. J. S. Holmes, Forester of the North Carolina Geological and Economic Survey, and Mr. H. S. Sackett of the United States Forest Service.

The value of the timber crop in North Carolina is exceeded only by that of the cotton and corn crops. According to the United States Census Bureau, the value of the lumber-cut of this State amounted in 1908 to \$15,000,000.

The following report shows that half of this lumber was purchased by firms in this State and manufactured by them into a finished product. For this lumber, together with a small amount of logs, billets, and timber in other forms which they used, these firms paid something over \$10,000,000.

This enormous industry has been dependent for its supply of raw material almost entirely on timber that has grown up under natural conditions, the present owners being in no way responsible or assisting in its production, much of the timber having been growing for 200 to 300 years. As this old timber disappears, as it is rapidly doing, the methods of the producers will have to change, or else one of two things

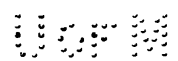
must happen: either this timber will have to be procured outside the State or these large and valuable industries, second only in importance to cotton manufacture, will have to shut down.

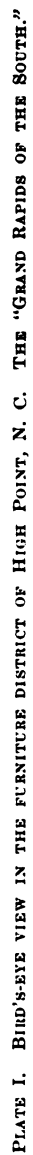
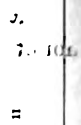
As long as both the growing and the manufacture of this timber can be carried on profitably in this State, we cannot afford to give up either part of this twofold industry. North Carolina probably contains as large a proportion of mountain land specially suitable for the growth of hardwoods, which is what most of these industries require, as any other State. We can, therefore, grow the raw material more cheaply, and furnish it to these factories at a lower price.

This report is intended as an incentive to improvement and as an aid in bringing about better conditions, partly in demonstrating the value of our forests to the people of the State, but chiefly by enlarging the market for the lower grades of wood by letting other parts of the country know what North Carolina can furnish them.

By protecting the forests from fire so that the annual rate of growth can be continually increasing, and by closer utilization, thus preventing waste in the woods and at the mill, there is no reason why the annual yield of our forests cannot after a comparatively short time be doubled.

If as much care and foresight were exercised in the growing, protection, harvesting, and marketing of the raw material as is now given to the manufacture of the finished product, there need be no fear of an impending timber famine on the part of the wood-using industries of North Carolina.





WOOD-USING INDUSTRIES OF NORTH CAROLINA.

BY

ROGER E. SIMMONS, UNDER THE DIRECTION OF J. S. HOLMES AND H. S. SACKETT.

INTRODUCTION.

For many years North Carolina has been one of the leading lumber-producing States. Its cut in 1908 exceeded one billion board feet, an amount equaled by only thirteen States. It not only produces a large quantity of rough lumber, but its rating is very high as a manufacturer of finished products. Though there are no means of definitely determining the relative importance of this State among the leading wood-manufacturing States, it is safe to say that few surpass North Carolina in the total amount of the raw material annually consumed in manufacture. It is probable that in no other State in the Union is there so large a percentage of home-grown raw material put into the products of its manufacture. There is converted annually into these products 676,000 000 feet, of which 96 per cent is produced in the State. This amount of material used by the woodworking industries does not include rough lumber in the form of boards, planks, scantling, and structural timber, as these go largely into buildings or other structural work in their rough form. Neither are cross-ties, veneer, cooperage stock, shingles, telegraph and telephone poles included. These are accounted for in special statistics issued annually by the Bureau of the Census, as explained in another part of this report.

KINDS OF WOODS USED.

Thirty-two species of wood, with the amount used and the cost of each at the factory, are presented in Table 1. Where several species of the same genus are all equally suitable for the purpose desired, it was often impossible to get information upon them separately. For instance, white, red, Spanish, and chestnut oak are all acceptable to the furniture manufacturer as raw material. When purchased from local mills, as much of this material is, it was received as "oak," without specifying the particular kinds. In the tables giving information in summary form the general terms of oak, ash, gum, etc., are employed, while in the tables dealing with the individual industries, the exact species are given as reported.

Notwithstanding the heavy drain made for many years on the yellow-pine forests of North Carolina, depleting to a large extent the virgin growth, the amount of this kind of wood consumed by the manufacturers takes the lead over all others. Of the total quantity of yellow-pine

lumber produced in 1908 in this State, according to figures annually compiled, 50 per cent was converted into finished form ready for the consumer. Yellow pine stands first in Table 1 with 62 per cent of the total quantity of all kinds of woods manufactured, followed by oak with 21 per cent, poplar 5.3 per cent, gum 3.2 per cent, white pine 2 per cent, and the other twenty-six species in decreasing amounts. This table shows what percentage of the total quantity grown in and out of the State was supplied by each species. It is interesting to note that of the thirty-two species reported, North Carolina furnished all, or a large part of all, but two. The two foreign woods are mahogany and Circassian walnut. This emphasizes how very important the home supply of lumber is to the people of North Carolina, only 4 per cent coming from outside.

TABLE 1.—SUMMARY OF THE ANNUAL CONSUMPTION OF RAW MATERIAL GROWN IN AND OUTSIDE OF NORTH CAROLINA.

KIND OF WOOD.	Total Quantity Feet b. m.	Total Cost Delivered at Factory.	SOURCE OF RAW MATERIAL.	
			North Carolina, Per cent.	Outside of North Carolina, Per cent.
Yellow pine.....	421,706,000	\$5,122,346.65	98.3	1.7
Oak.....	145,059,000	2,666,669.95	96.6	3.4
Yellow poplar.....	35,263,000	645,214.95	77.0	23.0
Gum.....	26,873,000	250,426.41	98.9	1.1
White pine.....	13,115,000	207,230.28	100.0	.....
Hickory.....	11,025,000	273,971.30	53.3	46.7
Chestnut.....	7,761,000	127,617.80	96.1	3.9
Maple.....	4,110,000	64,739.80	98.9	1.1
Cypress.....	2,865,000	41,850.00	97.7	2.3
Locust.....	2,600,000	36,400.00	100.0	.....
Ash.....	1,417,000	36,350.12	99.3	.7
White cedar.....	1,050,000	16,504.00	100.0	.....
Dogwood.....	600,000	11,250.00	100.0	.....
Black walnut.....	591,000	24,330.00	30.6	69.4
Birch.....	513,000	14,147.95	88.9	11.1
Sycamore.....	369,000	4,110.12	95.9	4.1
Basswood (linn).....	265,000	5,500.00	100.0	.....
Elm.....	197,000	2,610.00	100.0	.....
Beech.....	155,000	3,059.75	100.0	.....
Persimmon.....	150,000	3,000.00	100.0	.....
Spruce.....	150,000	1,875.00	100.0	.....
Red cedar.....	145,000	3,925.00	100.0	.....
Mahogany.....	64,250	9,555.29	.....	100.0
Cottonwood.....	30,000	360.00	100.0	.....
Cherry.....	29,000	1,398.00	100.0	.....
Hemlock.....	25,000	300.00	100.0	.....
Kalmia (mountain laurel).....	22,000	220.00	100.0	.....
Butternut (white walnut).....	20,000	800.00	100.0	.....
Cucumber.....	15,000	180.00	100.0	.....
Buckeye.....	10,000	400.00	100.0	.....
Box elder (Silverbell).....	5,000	60.00	100.0	.....
Circassian walnut.....	3,000	600.00	.....	100.0
All others*.....	3,000	240.00	.....	100.0
Totals.....	676,166,250	9,577,242.37	96.0	4.0

*Includes imported woods not mentioned.

Eighteen of the woods demanded by the various industries are grown entirely in the State. In the case of eight others, 90 per cent is home-grown, while for only one American species is as much as 50 per cent obtained from other States.

HOME-GROWN WOODS USED IN NORTH CAROLINA.

The characteristic growth of the timber, as well as the surface, soil, and other natural conditions, divide the State of North Carolina into three well-known regions, the Coastal Plain, the Piedmont region, and the Mountain region. Table 2 gives the amount in feet consumed in the three regions. Only State-grown wood is considered in this table. The total used by the manufacturers in these regions represents all of the timber grown in North Carolina which goes into finished products. The prices paid for lumber used in these sections, as well as the average price for each kind of wood grown in this State, are likewise shown.

The Coastal Plain region takes approximately 63 per cent of the yellow pine, while the Piedmont region uses only 36 per cent, and the Mountain region 1 per cent. Ninety per cent of the 140,000,000 feet of oak used in the State is manufactured in the Piedmont region; 72 per cent of the gum in the Coastal Plain, and none in the Mountain region; while the Mountain region manufactures most of the spruce and basswood, and uses a greater number of kinds than either of the other regions. The manufacturers in the State use a total of 650,153,000 feet a year of this home-grown material at an average cost per M of \$14.13. Of this amount, the Piedmont region takes 53 per cent, the Coastal Plain 44 per cent, and the Mountain region 3 per cent.

It is of as much interest to compare the prices paid in each of the three regions as it is the quantities of material used. Where a wood is indigenous to one region and not to the others, its price is expected to be lower in that region, especially if large amounts of all grades are manufactured. An exception, however, is noted in the case of ash in the Mountain region where it is most abundant, and its price is higher than in the other regions. This difference in price is probably owing to the fact that manufacturers in the different regions demand different grades of this lumber.

TABLE 2.—SUMMARY OF THE ANNUAL CONSUMPTION OF WOODS GROWN IN NORTH CAROLINA.

KIND OF WOOD.	COASTAL PLAIN REGION.		PIEDMONT REGION.		MOUNTAIN REGION.		STATE OF NORTH CAROLINA.	
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.
Yellow pine.....	260,262,000	\$ 11.94	151,218,000	\$ 12.40	3,601,000	\$ 15.66	415,081,000	\$ 12.14
Oak.....	1,437,000	19.80	133,933,000	18.31	4,808,000	10.26	140,178,000	18.06
Yellow poplar.....	4,372,000	17.03	22,294,000	17.75	499,000	16.33	27,165,000	17.61
Gum.....	19,895,000	8.14	6,678,000	12.09	540,000	18.52	26,573,000	9.14
White pine.....	10,000	27.50	12,565,000	15.67	900,000	16.41	13,115,000	15.80
Chestnut.....	500,000	19.00	6,061,000	16.31	1,475,000	10.40	7,461,000	16.50
Hickory.....	160,000	38.25	4,245,000	24.43	105,000	19.26	5,890,000	21.26
Maple.....	650,000	9.60	3,310,000	17.09	600,000	14.00	4,965,000	15.95
Cypress.....	2,750,000	13.67	2,000,000	14.00	55,000	30.00	2,750,000	13.67
Locust.....	359,000	23.02	993,000	26.33	150,000	15.00	2,600,000	14.00
Ash.....	1,050,000	15.72	450,000	20.00	102,000	22.04	1,407,000	25.62
White cedar.....	50,000	7.00	356,000	28.06	200,000	17.00	600,000	15.72
Dogwood.....	175,000	12.75	65,000	32.31	20,000	50.00	458,000	26.72
Birch.....	40,000	32.00	121,000	44.21	20,000	50.00	354,000	10.76
Beech.....	135,000	16.74	20,000	40.00	150,000	20.00	265,000	20.75
Persimmon.....	175,000	12.75	22,000	18.64	30,000	12.00	107,000	13.38
Basswood (linn).....	175,000	12.75	22,000	18.64	30,000	12.00	181,000	42.15
Elm.....	40,000	32.00	121,000	44.21	20,000	50.00	155,000	19.74
Black walnut.....	135,000	16.74	20,000	40.00	150,000	20.00	150,000	20.00
Spruce.....	145,000	27.08	145,000	27.08	150,000	18.75	150,000	18.75
Red cedar.....	2,000	24.00	2,000	24.00	25,000	12.00	145,000	27.08
Cottonwood.....	2,000	24.00	2,000	24.00	25,000	12.00	30,000	12.00
Cherry.....	2,000	24.00	2,000	24.00	25,000	12.00	29,000	46.41
Hemlock.....	2,000	24.00	2,000	24.00	25,000	12.00	25,000	12.00
Kalmia (mountain laurel).....	2,000	24.00	2,000	24.00	25,000	12.00	22,000	10.00
Butternut (white walnut).....	2,000	24.00	2,000	24.00	25,000	12.00	20,000	40.00
Cucumber.....	2,000	24.00	2,000	24.00	25,000	12.00	15,000	12.00
Buckeye.....	2,000	24.00	2,000	24.00	25,000	12.00	10,000	40.00
Box elder (silverbell).....	2,000	24.00	2,000	24.00	25,000	12.00	5,000	12.00
Totals.....	291,845,000		344,947,000		13,359,000		650,151,000	13.83

WOODS GROWN OUTSIDE OF NORTH CAROLINA.

Table 2 treats of the raw material grown in North Carolina, while Table 3 deals with the lumber grown outside of the State. This table gives the quantity of wood used in manufacture, the average cost, delivered at the factory, and the percentage of the different species shipped into the State, grown in the several States mentioned.

The woods brought from outside of the State in 1909 for the wood-using industries aggregated 26,000,000 feet. It is of interest to note that 93 per cent of this quantity is grown in States contiguous to North Carolina. Tennessee ranks first, furnishing 51 per cent; South Carolina, Virginia, and Kentucky follow in the order named, supplying 20, 16, and 6 per cent, respectively. The imported woods amount to little over one-quarter of one per cent of the total. The average price paid for all home-grown material, as shown in Table 2, was \$14.13. Table 3, which follows, gives the average cost at the factory of the woods brought from a distance at \$26.29, making a difference of \$12.16 per M feet in the cost of the woods grown in and out of the State.

A greater quantity of yellow poplar is shipped into North Carolina than any other wood used by the manufacturers. The 8,068,000 feet grown in other States, as shown in the table, is 23 per cent of the total quantity of poplar used. North Carolina pine, following next in the quantity of wood grown outside of the State, is 6,625,000 feet. Two-thirds of this amount is brought from South Carolina, while the remainder is grown in Virginia and Georgia. Sixty-nine per cent of the black walnut used is shipped into the State, and 43 per cent of the hickory. No other wood comes up to these in the relative quantity shipped in. Tennessee and Kentucky furnished most of the hickory.

TABLE 3.—SUMMARY OF THE ANNUAL CONSUMPTION OF WOODS GROWN OUTSIDE OF NORTH CAROLINA.

KIND OF WOOD.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	PERCENTAGE DISTRIBUTION BY STATES.					
			Tennessee.	South Carolina.	Virginia.	Kentucky.	Georgia.	Various States. Imported.
Yellow poplar.....	8,068,000	21.26	84.2	5.0	8.1	1.2	1.5	.....
North Carolina pine.....	6,625,000	12.80	.....	66.0	31.0	.....	3.0	.....
Hickory.....	5,145,000	25.63	65.2	.....	1.3	19.9	.....	13.6
Red and white oak.....	4,831,000	27.80	39.1	.....	25.4	8.6	6.7	100.0
Black walnut.....	410,000	40.73	.....	.....	.....	.....	.....	.....
Chestnut.....	300,000	15.00	66.7	.....	33.3	.....	.....	.....
Red and tupelo gum.....	300,000	25.00	.....	100.0	.....	.....	.....	.....
Cypress.....	115,000	36.96	.....	100.0	.....	.....	.....	100.0
Mangrove.....	64,250	147.42	.....	.....	.....	.....	.....	.....
Birch.....	55,000	34.73	.....	.....	.....	.....	100.0	.....
Maple.....	45,000	33.33	.....	.....	.....	.....	.....	.....
Sycamore.....	15,000	20.00	.....	.....	.....	.....	82.2	.....
Aspen.....	10,000	30.00	.....	.....	100.0	.....	.....	.....
Circassian walnut.....	3,000	200.00	100.0	.....	.....	.....	.....	100.0
All others*.....	3,000	80.00	.....	.....	.....	.....	.....	66.7
Totals.....	26,014,250	28.29	50.9	20.0	15.9	5.9	2.5	4.5
								.3

*Includes only imported woods not mentioned.

INDUSTRIES UTILIZING WOOD.

An industry, as it is considered in this report, embraces all manufacturing concerns which produce commodities that are similar or closely related. In North Carolina these may be classified as follows: First, those making commodities in their entirety, ready for the consumer, as baskets, flooring, coffins; second, those manufacturing articles which are component parts of others, as hubs, spokes, or built-up tops; and third, those which take the several parts already manufactured, and merely assemble them to make a finished product. Some vehicle manufacturers are of this class. Table 4, which follows, contains no statistics obtained from the third class, but is compiled from data supplied by classes one and two.

The tendency in manufacturing is toward specialization, and as this becomes more general the number of industries increases, while the products of the separate manufacturers become less varied. Chairs, tables, kitchen safes, furniture, and upholstered furniture are, as a rule, products of different factories. Instead of all of these commodities being the output of a single furniture factory, as was formerly the case, they are separate and distinct industries in North Carolina, and are so treated in this report. This same tendency is seen, also, in other lines of manufacture, such as boxes and agricultural implements.

The manufacturing concerns of North Carolina, as shown in Table 4, are grouped in twenty-one industries. The line of distinction between these was in some cases quite arbitrarily drawn, difficulty being experienced in determining the boundary properly separating those industries whose products are very similar. Take, for example, the industries of flooring, siding, and stock molding; sash, doors, and blinds; and store and office fixtures. The sash and door factories often turn out interior finish of a high character which clearly belongs to the last-named industry. They also manufacture a finish of a class identical with regular stock molding produced by the planing mills of flooring, ceiling, siding, etc., manufacturers. Similar overlappings occur with other industries, making necessary a grouping of the data and its apportionment among the several industries concerned. Where less than three manufacturers producing similar commodities reported, separate classification was impracticable without revealing the information of the concerns reporting. To avoid this, and at the same time include the data in the report, several industries were combined under one heading. Shuttles, spools, bobbins, picker-sticks, and skewers will be found included under the heading of shuttles, spools, bobbins, etc.

Table 4 as presented herewith shows the total amount of raw material used in the State by manufacturers, the average price paid by the industries, the total amount of money invested annually in raw material, and the percentage which each one of these industries used of the total in North Carolina. To what extent the several industries purchase their lumber outside of the State can likewise be determined. It will be noted that this is expressed in approximate percentages of the amounts grown in and outside of North Carolina. Manufacturers of flooring, ceiling, siding, etc., purchased only 1 per cent outside of the State. Vehicle manufacturers purchased 44 per cent in other States, while eleven industries, as will be seen from the table, do not go outside of North Carolina for any of the raw material used.

TABLE 4.—ANNUAL CONSUMPTION OF RAW MATERIAL IN NORTH CAROLINA, BY INDUSTRIES.

INDUSTRY.	QUANTITY.		COST.	WHERE GROWN.		
	Feet b. m.	Per cent.		Total.	Average per M bd. ft. Delivered at Factory.	In North Carolina, Per cent.
Table 7. Flooring, ceiling, siding and stock moldings.....	310,330,000	45.9	\$ 3,850,437.90		12.41	99.0
Table 8. Furniture.....	100,343,250	14.9	1,828,752.34		18.23	92.6
Table 9. Boxes, box shooks, and crating.....	68,063,000	10.1	650,880.98		9.56	97.0
Table 10. Sashes, doors, blinds, etc.....	57,684,000	8.5	783,862.77		13.60	98.9
Table 11. Chairs.....	47,325,000	7.0	867,221.70		18.33	97.1
Table 12. Tables, stands, and extension tables.....	31,868,000	4.7	543,939.46		17.06	91.7
Table 13. Trucks, vehicles and wagons.....	15,636,000	2.3	421,273.43		26.30	56.0
Table 14. Fruit and vegetable packages (vaneer).....	8,862,000	1.3	67,805.48		7.65	100.0
Table 15. Insulator pins and brackets.....	5,600,000	.8	51,400.00		9.18	100.0
Table 16. Coffins, caskets and casket cases.....	4,775,000	.7	81,599.72		17.09	92.9
Table 17. Tool and machinery handles.....	3,595,000	.5	62,193.50		17.30	100.0
Table 18. Shuttles, spools, bobbins, etc.....	3,480,000	.5	58,055.30		16.63	100.0
Table 19. Farming implements.....	3,391,000	.5	40,534.83		11.95	100.0
Table 20. Kitchen safes, cabinets and cupboards.....	3,325,000	.5	49,698.75		14.95	100.0
Table 21. Cross-arms (telephone and telegraph).....	2,816,000	.4	41,282.54		14.66	100.0
Table 22. Pipes, pulleys and mine rollers.....	2,532,000	.4	21,240.00		17.00	100.0
Table 23. Store and office fixtures, mantels, etc.....	2,364,000	.4	31,607.67		34.52	81.2
Table 24. Musical instruments.....	1,800,000	.3	44,450.00		24.70	66.7
Table 25. Boat planking.....	800,000	.1	11,504.00		14.40	100.0
Table 26. Excelsior.....	800,000	.1	6,352.00		8.31	100.0
Table 27. Woodenware.....	775,000	.1	13,150.00		17.00	100.0
Totals.....	676,166,250	100.0	9,577,242.37			

CONSUMPTION BY INDUSTRIES AND REGIONS.

Table 2 presented statistics showing the quantity of raw material grown in the State and used in the Coastal Plain, Piedmont, and Mountain regions of North Carolina. Table 5, which follows, has been compiled to show by industries the total consumption of wood for manufacture in the three regions. The average price paid per M feet, and the percentage of the total quantity of wood used by the various industries in each one of the regions, are also shown. For illustration, the box-makers in North Carolina used 68,063,000 feet of lumber, and 61.5 per cent of it was manufactured in the Coastal Plain, 38.5 per cent in the Piedmont region, and none in the Mountain districts. In figures it stands 41,903,000 feet for the Coastal region and 26,160,000 for the Piedmont. Again, in the sash and door industry the Piedmont region consumes 73.5 per cent, the Coastal Plain 22.3, and the Mountain region 4.2 per cent of the total material used by this industry in the State.

Of the woods used in making flooring, ceiling, siding, boxes, fruit and vegetable packages, farming implements, mine rollers, boat siding, and woodenware, more is consumed in the Coastal Plain than in the other two regions together. In the Piedmont region over 50 per cent of the total quantity of material used by thirteen industries is consumed in making furniture, sashes, doors, and blinds, chairs, tables, vehicles, coffins, and caskets, handles, shuttles, spools and bobbins, kitchen safes and cupboards, cross-arms, store and office fixtures, mantels and interior trimmings, and excelsior. The one remaining industry, manufacturing insulator pins and brackets, consumes in the Mountain region 64 per cent of wood entering into these products.

There are 676,166,250 feet of raw material going into manufactured articles annually in North Carolina, and of this total 43.9 per cent is used by the industries located in the Coastal Plain region, 54.2 per cent by the manufacturers in the Piedmont section, and 1.9 per cent by those of the Mountain region. Nearly six million dollars is expended annually in the Piedmont region for raw material delivered at the factory, three and one-half million is spent in the Coastal Plain, and less than two hundred thousand dollars in the Mountain region. This absence of wood-using industries in the mountains is accounted for chiefly by the lack of transportation facilities, which has existed in this region until quite recently, and the consequent cost of getting timber to market. The higher grades, which are the only ones that can profitably be hauled over these mountain roads any considerable distance, are usually shipped to the northern and western markets. With improved roads, however, and additional railroads, there is no reason why the Mountain region should not manufacture the greater part of its own raw material.

TABLE 5.—ANNUAL CONSUMPTION OF RAW MATERIAL IN NORTH CAROLINA, BY INDUSTRIES AND REGIONS.

INDUSTRY.	COASTAL PLAIN REGION.			PIEDMONT REGION.			MOUNTAIN REGION.		
	Quantity.		Cost.	Quantity.		Cost.	Quantity.		Cost.
	Feet b. m.	Per cent.		Feet b. m.	Per cent.		Feet b. m.	Per cent.	
Flooring, ceiling, siding and stock moldings.	217,690,000	70.1	\$ 2,714,793.80	90,360,000	29.1	\$ 1,099,216.60	2,280,000	8	\$ 26,327.50
Furniture.	3,751,000	3.7	56,375.86	94,401,250	94.2	1,739,148.20	2,191,000	2.1	36,228.28
Boxes, box shooks and crating.	41,903,000	61.5	357,391.58	26,160,000	38.5	283,489.40	2,386,000	4.2	41,543.24
Sashes, doors, blinds, etc.	12,883,000	22.3	160,642.65	42,407,000	73.5	581,676.88			
Chairs.	250,000	.5	3,500.00	47,075,000	99.5	863,721.70			
Tables, stands and extension tables.	20,000	(a)	300.00	31,141,000	97.7	532,187.38	707,000	2.3	11,452.08
Trucks, vehicles and wagons.	2,381,000	15.2	61,546.81	13,255,000	84.8	359,726.62			
Fruit and vegetable packages (vener).	8,862,000	100.0	67,805.48						
Insulator pins and brackets.				2,000,000	35.7	28,000.00	3,600,000	64.3	23,400.00
Coffins, caskets and casket cases.	2,160,000	45.2	30,287.52	2,615,000	54.8	51,312.20			
Tool and machinery handles.				2,120,000	58.8	46,873.20	1,475,000	41.2	15,320.30
Shuttles, spools, bobbins, etc.				3,150,000	90.8	64,003.60	330,000	9.2	4,061.70
Farming implements.	2,950,000	86.9	31,351.45	416,000	12.3	8,683.38	25,000	.8	500.00
Kitchen safes, cabinets and cupboards.				3,325,000	100.0	49,668.75			
Cross-arms (telephone and telegraph).	250,000	8.9	4,375.00	2,566,000	91.1	36,907.54			
Pipes, pulleys and mine rollers.	2,510,000	99.1	21,020.00				22,000	9	220.00
Store and office fixtures, mantels, etc.	66,000	3.9	1,320.00	1,750,000	74.0	62,940.77	548,000	22.1	17,346.90
Musical instruments.				1,800,000	100.0	44,450.00			
Boat planking (worked).	800,000	100.0	11,504.00						
Excelsior.	650,000	84.0	11,200.00	800,000	100.0	6,352.00	100,000	12.7	1,500.00
Woodenware.				25,000	8.3	450.00			
Totals.	297,126,000	43.9	3,533,414.15	363,366,250	54.2	5,858,838.22	13,674,000	1.9	184,990.00

a Less than one-tenth of one per cent.

FORM, GRADE, AND SIZES OF RAW MATERIAL.

In the foregoing tables and discussions the raw material used in North Carolina has been considered, first, as to quantity and species, and then as to industries. Table 6 treats of the raw material from a different standpoint, presenting the forms desired, the grades in which it is purchased, and the range of sizes acceptable. For instance, by consulting the table it can be learned that seventy-three concerns are classified under furniture. The material purchased by them is all in the form of rough-sawed lumber. Forty-five of these firms purchased log-run grades, while twenty-eight report buying established grades. The sizes of rough lumber purchased by the furniture makers range in thickness from $\frac{3}{4}$ to $4\frac{1}{2}$, $\frac{1}{4}$ or 1 inch being the size most commonly used. As in other industries, the fact of the furniture manufacturers buying a portion of their raw material in the form of rough-sawed squares is indicated in the table by the asterisk (*). The smallest sizes in lumber purchased by any of the manufacturers making up the several industries can be seen from the last column of the table. This does not include squares.

That the manufacturers in North Carolina are located near the source of timber supply accounts for the fact that thirteen out of the twenty-one industries listed in the table secure all or some portion of their raw material in log form, seventeen report using rough-sawed lumber as raw material, while nine industries used billets or bolts from which to manufacture their products. See Plates II and III.

Owing to the incomplete data supplied by many of the firms reporting, these statistics do not present the matter in the definite form originally intended by this study. In its present shape, however, this report contains much useful information. It should help those wishing to sell their timber by acquainting them with the form in which each different industry desires raw material, whether in logs, in bolts, or in rough-sawed lumber. Where the raw material is rough lumber they can get some idea of the sizes used and the grades which will be received, whether log-run or established grades. A sawmill operator can learn what industries use sawed squares. By the addition of a rip and cut-off saw to his machinery he can manufacture squares from the inferior lumber that would otherwise be waste.

It will be noticed that many of the industries using rough lumber buy it in log-run rather than in established grades. This custom doubtless operates to the disadvantage of both the lumberman and the wood user. The lumberman could saw the lower grades into squares, and, grading his best lumber according to grading rules, would realize more for the

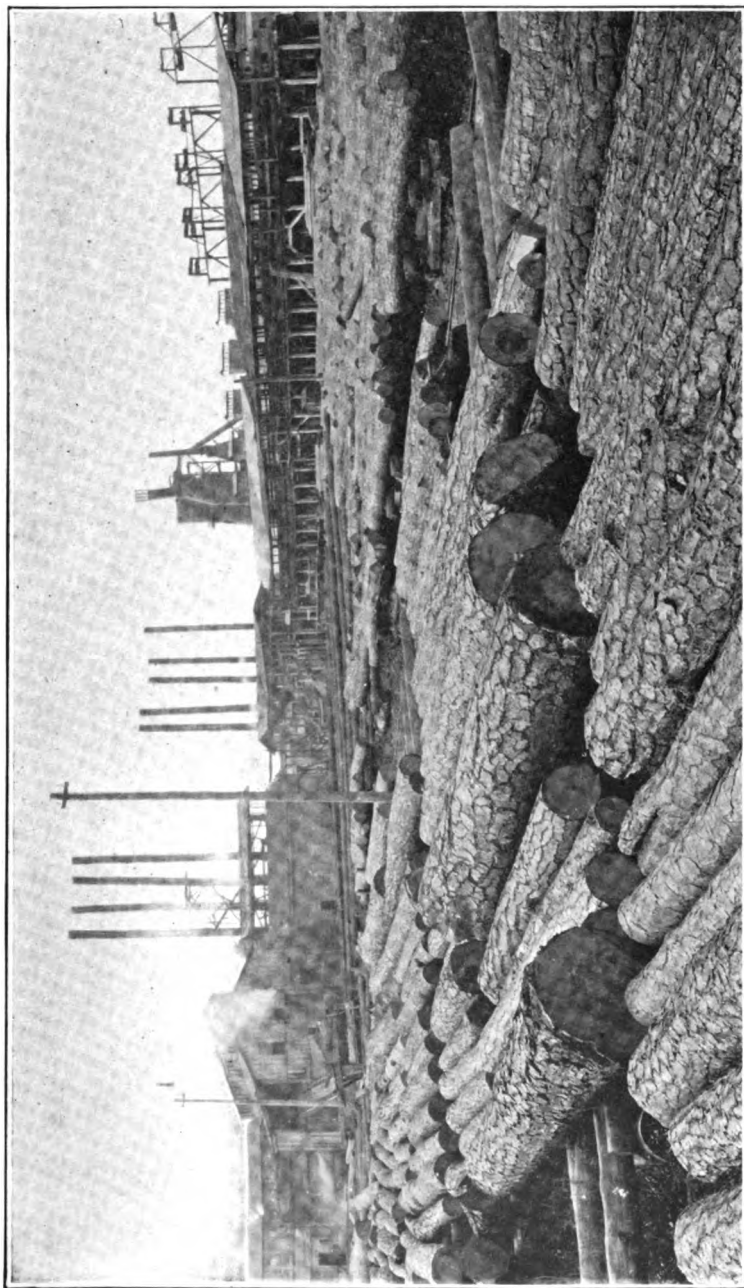


PLATE II. MILL AND YARD OF GOLDSBORO LUMBER COMPANY, DOVER, N. C. MANUFACTURERS OF HIGH-CLASS FLOORING, CEILING, SIDING AND MOLDING. THE PINE LOGS IN THE FOREGROUND ARE READY TO BE SAWED.

TABLE 6.—NUMBER OF FIRMS, AND FORM, GRADE, AND SIZE OF RAW MATERIAL REQUIRED.

Industry.	Number of Firms Reporting.	Form of Raw Material, (in percentage of quantity).			Firms Buying Lumber.		Size of Raw Material Required.			Smallest Size Reported of Raw Material Purchased.
		Logs, Per cent.	Bolts and Billets, Per cent.	Lumber, Per cent.	Mainly Log-run, Number.	Mainly in Established Grades, Number.	Ranging—		Principally.	
							From—	To—		
Flooring, ceiling, siding and stock moldings	136	59.3		40.7	83	53	4-4	10-4	4-4	1"x3'-8"
Furniture	73			100.0*	45	28	3-4	16-4	4-4	1"x3'-10"
Boxes, box shoofs and crating	46	26.7		73.3	28	18	3-8	6-4	4-4	1"x3'-6"
Sashes, doors, blinds, etc.	72	17.2		82.8	28	44	4-4	16-4	4-4	1"x3'-8"
Chairs	30	11.2		88.8*	10	20	4-4	10-4	Squares.	1"x3'-10"
Tables, stands and extension tables	20	3.7		96.3*	13	7	3-4	16-4	4-4 Lumber and squares.	1"x4'-any.
Trucks, vehicles and wagons	34	11.0		89.0*	4	30	3-8	12-4	Variable.	1"x4'-8"
Fruit and vegetable packages	15	68.7	31.3	45.0*			6" diam. and up.		12" logs.	1"x4'-8"
Insulator pins and brackets	3	35.0	20.0	89.5	3	4	4-4	8-4	Squares.	1"x4'-8"
Coffins, caskets and casket cases	7	10.6	68.2	26.0*					4-4	1"x4'-8"
Tool and machinery handles	10	5.8				10			Squares.	
Shuttles, spools, bobbins, etc.	7		55.8	44.2*		7			Squares.	
Farming implements	6		19.6	80.4*	1	5	4-4	12-4	Variable.	1"x4'-8"
Kitchen safes, cabinets and cupboards	5			100.0	1	4	4-4	10-4	Squares.	1"x4'-10"
Cross-arms (telephone and telegraph)	3		16.8	83.2*		3			Squares.	
Pipes, pulleys and mine rollers	4	70.4	28.6				6" diam. and up.		12" logs.	
Store and office fixtures, mantels, etc.	18			100.0*					4-4	1"x3'-10"
Musical instruments	3			100.0*	1	2	3-4	12-4	4-4	1"x3'-6"
Boat planking (worked)	3	100.0					8" diam. and up.		Logs	3" diameter
Excelsior	3		100.0				3" diam. and up.		Split billets.	6" diameter
Woodenware	3	45.7	25.7	28.6	2		6" diam. and up.		Logs.	6" diameter

*Purchase portion of lumber in form of "rough-sawed squares."

output of his mill than by selling the material in log-run form. The manufacturer would be relieved of the trouble of sawing the inferior grades into squares at the factory, and of the expense of paying for transportation, handling, and culling this log-run material, a large percentage of which will be a waste on his hands. The percentage of lumber suitable for further manufacture varies considerably in each consignment where materials are purchased in log-run grades. This brings about an element of uncertainty and often misunderstanding which can partly be eliminated if the lumber be purchased according to grades, and the squares according to specifications.

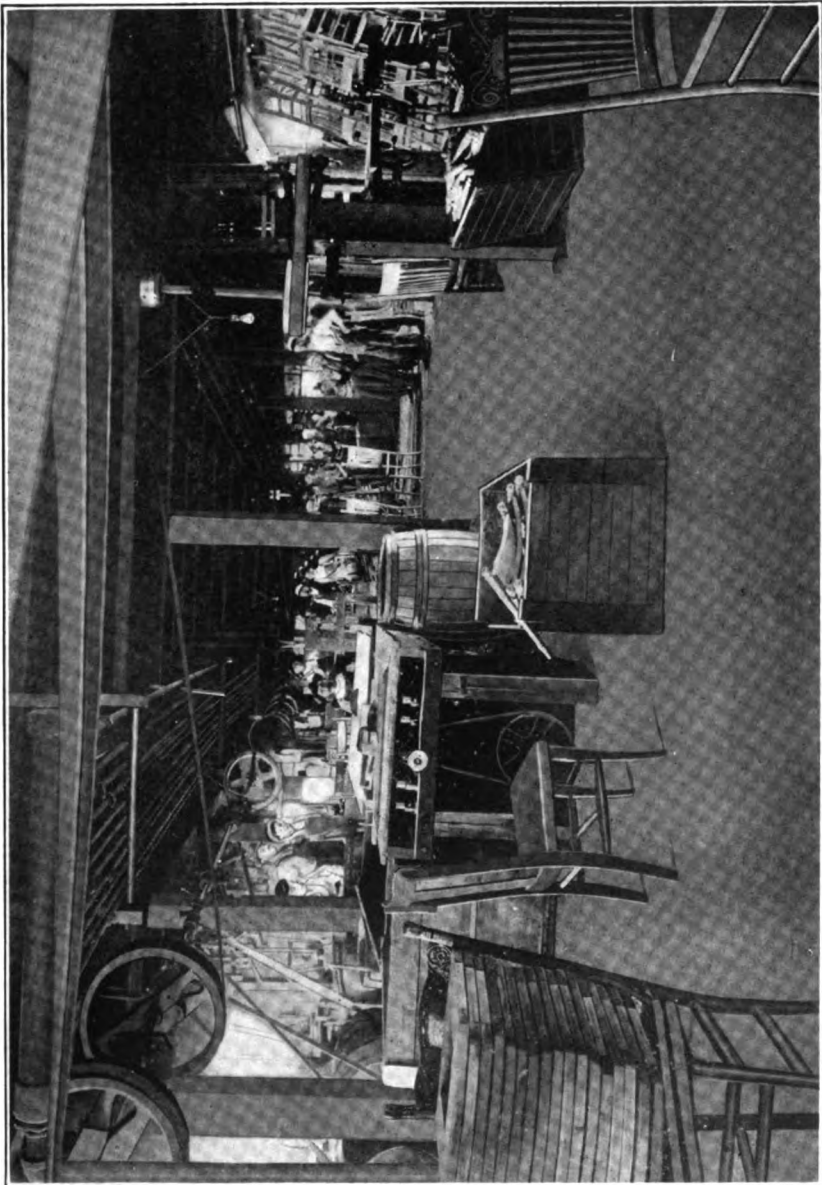


PLATE III. MAIN FLOOR OF THE FACTORY OF THE SOUTHERN CHAIR COMPANY, HIGH POINT, N. C.

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FLOORING, CEILING, SIDING, ETC.

So usual is it for sawmills in yellow-pine regions to market a large part of their cut in the form of flooring, ceiling, etc., that the public generally associates these products with the output of sawmills. The items in Table 7 represent that portion of the lumber produced by sawmills which, with the aid of planing-mill machinery, is converted into flooring, ceiling, siding, wainscoting, partitions, stock moldings, and casings. Roofers, box lumber, and boards merely surfaced are not considered as a part of these figures, as it is possible for these to be utilized later in the manufacture of other commodities. This table was compiled from statistics furnished by the sawmills which have planing-mill departments, but it includes, also, data furnished by the planing mills throughout the State which do not operate sawmills, but buy their lumber. Plate II.

This industry is the largest in the State, based on the quantity of wood used. Forty-five per cent of all the wood manufactured in North Carolina goes to these factories. The amount of money representing this raw material is over one-half of that expended by all the wood-using industries collectively. One-third of the number of wood users of all kinds in North Carolina are engaged in this industry.

By referring back to Table 6 it will be seen that more than half of the flooring, ceiling, and siding is produced by the same firm which cuts the rough lumber from the log from which these products are manufactured.

Yellow pine heads the list of species for quantity. It is the most abundant wood in the State, and the North Carolina manufacturers of these products use over fifty times as much of it as of all other woods combined. It enters into all the products of the flooring, ceiling, and siding industry, while yellow poplar is devoted mostly to the manufacture of siding and moldings. Cypress, being especially suitable for outdoor work, is used largely for porch flooring. Maple and oak are used in nominal amounts and are converted into flooring and inside trimming.

The proportion of each kind of wood used in this industry to the total of that wood used in the State is seen by consulting the last column of Table 7. This shows that 72.4 per cent of all the yellow pine manufactured in North Carolina is converted into flooring, ceiling, siding, etc., while 87 per cent of the cypress is taken by this industry, and 7 per cent of the poplar.

TABLE 7.—FLOORING, CEILING, SIDING, AND STOCK MOLDING.

KIND OF WOOD.	GROWN IN NORTH CAROLINA.			GROWN OUTSIDE OF NORTH CAROLINA.			TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
North Carolina and longleaf pine.....	302,075,000	\$ 12.35	3,050,000	\$ 13.48	305,125,000	\$ 12.37	\$ 3,775,717.90			72.40
Cypress.....	2,400,000	14.00			2,400,000	14.00	33,600.00			87.00
Yellow poplar.....	2,375,000	13.88			2,375,000	13.88	32,917.50			7.00
Red and white oak.....	400,000	17.85			400,000	17.85	7,140.00			27.00
Hard maple.....			25,000	40.00	25,000	40.00	1,000.00			60.00
Chestnut.....	5,000	12.50			5,000	12.50	62.50			.06
Totals.....	307,255,000	12.38	3,075,000	13.70	310,330,000	12.41	3,850,437.90			

FURNITURE.

The furniture industry, as here considered, includes bedroom suits and odd pieces like chiffoniers, dressing-tables, shaving-stands, sofas, hall racks, settees, lounges, sideboards, buffets, china closets, plate racks, music cabinets, piano stools and benches, parlor cabinets, etc. Chairs, tables, and kitchen safes are not included in this table, the manufacture of these being treated as separate industries. Had all furniture making been grouped in one industry, the 100,000,000 feet shown in Table 8 would be increased to 183,000,000 feet, while the total annual expenditure for raw material would aggregate \$3,240,000. This emphasizes the importance of the various branches of furniture making in North Carolina.

In the quantity of material used, as well as in its cost, furniture is second among the wood-using industries of the State. Fifteen per cent of the wood used in the State for manufacturing purposes goes into furniture, and 45 per cent into flooring, ceiling, siding, etc. The furniture makers paid an average price of \$18.23 per M feet, which was 50 per cent higher than that paid for raw material consumed by the flooring, ceiling, siding, etc., industry. See Plates I and III.

Only $7\frac{1}{2}$ per cent of the 100,000,000 feet of lumber used by the furniture manufacturers is grown outside of North Carolina. Sweet birch comes from Michigan and mahogany is imported; the remainder of that which is shipped into this State, including poplar, chestnut, and gum, comes from neighboring States.

The quantity of oak used was more than three times the amount of any other wood reported. Of this white oak leads in quantity, red oak follows, and Spanish oak is least. The best grades of oak are used for the outside of furniture, the lower grades for frame work and cores for veneering. The price paid for home-grown oak was \$18.41 per M feet. That shipped in cost \$10.47 more per M feet. The imported oak included much quarter-sawed oak. Fifty per cent of the oak shipped into the State for all purposes is taken by furniture manufacturers.

Yellow poplar comes second in importance in the manufacture of furniture. More yellow poplar is brought into the State by this industry than all other species combined. Furniture manufacturers pay \$1.51 per M feet less for home-grown poplar than for that bought in other States. The total amount of this wood used for furniture is 19,000,000 feet, a little more than 1 per cent of all the poplar manufactured in the State.

In relative quantity of wood used North Carolina pine comes third on the list in this industry. The amount used, however, is less than

one-third that of yellow poplar, and one-tenth that of the oak. Its use is chiefly for the inside of furniture and for veneer cores. The average cost per M feet was \$14.61 in this industry.

Seventeen per cent of the total amount of chestnut and the same proportion of the total amount of white pine used for all purposes of manufacture in North Carolina were used in this industry. Black walnut is not reported in the State by furniture makers, and mahogany is the only imported wood reported, a portion of which was purchased in the form of veneering. The average cost of mahogany delivered at the factory was \$159.21 per M feet.

TABLE 8.—FURNITURE (GENERAL).

KIND OF WOOD.	GROWN IN NORTH CAROLINA.		GROWN OUTSIDE OF NORTH CAROLINA.		TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Oak.....	63,331,000	\$ 18.41	2,556,000	\$ 28.88	65,887,000	\$ 18.41	\$ 1,229,748.00	45.42
Yellow poplar.....	14,526,000	17.10	4,428,000	18.61	18,954,000	17.20	332,189.00	1.40
North Carolina pine.....	5,970,000	14.61			5,970,000	14.61	86,221.70	1.40
Chestnut.....	4,555,000	15.60	100,000	15.00	4,655,000	15.60	72,558.00	16.90
White pine.....	2,210,000	18.28			2,210,000	18.28	40,388.80	16.90
Red and tupelo gum.....	1,415,000	17.36	300,000	25.00	1,715,000	19.28	33,064.40	7.03
Maple.....	325,000	18.22			325,000	18.22	5,921.50	8.00
White ash.....	258,000	20.85			258,000	20.85	5,379.30	18.20
Sycamore.....	104,000	14.04			104,000	14.04	1,460.16	28.20
Beech.....	75,000	22.13			75,000	22.13	1,659.75	43.40
Birch.....	71,000	21.00	55,000	34.73	126,000	28.30	3,401.00	24.60
Mahogany.....			39,250	159.21	39,250	159.21	6,250.00	61.10
Basswood.....	25,000	20.00			25,000	20.00	500.00	9.40
Totals.....	92,865,000	17.81	7,475,250	23.37	100,340,250	18.23	1,828,752.34	

BOXES AND CRATES.

As each year the virgin stands of timber in North Carolina approach nearer to exhaustion the sawmill man seeks to supply his demands more and more from the second and even the third growths of timber. This necessity has become well-nigh universal in the yellow-pine districts, resulting in a considerable increase in the quantity of the lower grades of lumber. The necessity for utilizing these lower grades is, no doubt, one of the chief factors in developing, in North Carolina, the manufacture of boxes. There is a grade of yellow-pine lumber which is known to the trade as "boxing"; this, however, is not included in these statistics. The figures and items in Table 9 refer to material actually consumed in the making of boxes and crates by the several woodworking industries of the State. The box manufacturers use over 68,000,000 feet of timber annually, making this industry third in the State for quantity used. The cost of the material was \$651,000, an average price of \$9.56 per M feet. All the material going into boxes and box shooks is supplied by North Carolina, excepting 2,000,000 feet, which is reported grown in South Carolina at \$1 more per M feet than the home-grown yellow pine. North Carolina pine makes up two-thirds of the box material, while gum is second in importance. For exportations, especially to South Africa and Australia, gum boxes are in great demand. The trade to these foreign countries contends that goods sell more readily in packages made of this material. This has brought about an increasing demand for gum box shooks, and accounts for the fact that 54½ per cent of all the gum consumed in the State of North Carolina is manufactured into these products. White pine is also an important wood for the box makers, who use 47 per cent of all this wood purchased by the manufacturers in the State. A fourth of the box makers in North Carolina cut their material from the log, and the industry is becoming closely allied with the large sawmills which are striving more and more to put to some use those grades of lumber that would otherwise go to waste. Boxes and box shooks are not all made of the lower grades of lumber, as they must vary in price and grade according to use. Some high-priced boxes require the best grades of lumber, such as trunks, sample cases, and packages designed for the shipment of goods of fine textures where the exclusion of moisture and dust is of prime consideration.

TABLE 9.—BOXES, BOX SHOOKS, AND CRATING.

KIND OF WOOD.	GROWN IN NORTH CAROLINA.		GROWN OUTSIDE OF NORTH CAROLINA.		TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.		Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	
North Carolina pine.....	43,227,000	\$ 9.12	2,000,000	\$ 10.38	45,227,000	\$ 9.17	10.70
Red and tupelo gum.....	13,301,000	8.21	.....	.....	13,301,000	8.21	54.57
White pine.....	6,210,000	13.18	.....	.....	6,210,000	13.18	47.40
Yellow poplar.....	2,528,000	14.75	50,000	17.00	2,578,000	14.79	12.20
Maple.....	500,000	8.50	.....	.....	500,000	8.50	12.20
Cypress.....	250,000	10.00	.....	.....	250,000	10.00	9.04
Totals.....	66,014,000	9.53	2,050,000	10.54	68,064,000	9.56	650,880.98

SASH, DOORS, BLINDS, ETC.

The makers of sash, doors, and blinds often manufacture inside and outside finish for buildings. The industry differs from that which turns out flooring, ceiling, stock molding, and siding, in that it calls for more complicated machinery and usually requires labor of greater skill. Special designs are frequently required, and each must be worked out with judgment and care. Stairways, newel and landing posts, archways, special wainscoting, casing and moldings to order, store fronts, cornice work, porch work, brackets, and spindles, are illustrations.

Fourteen kinds of wood are demanded by the sash and door factories of North Carolina, and 57,600,000 feet are used yearly, which is more than $8\frac{1}{2}$ per cent of all the wood manufactured in the State. Yellow pine, which includes North Carolina pine and some longleaf, leads the list in quantity and cost. The quantity is 85 per cent of the total wood used by this industry, of which 1,000,000 feet, mainly longleaf pine, was shipped into the State from South Carolina. The imported pine cost about \$1 per M feet more than that grown in North Carolina. White pine is next in quantity and constitutes 27 per cent of all the white pine manufactured in the State. It is all grown in North Carolina and, as shown in the table, was purchased at an average price of \$17.95, delivered at the factory. The price paid for yellow poplar recorded in Table 10 was \$2.09 more per M feet than was paid by the flooring, ceiling, siding, etc., manufacturers, and \$1.25 less than the price paid by the furniture makers. Spruce, purchased at \$12.50 per M feet, cottonwood, cucumber, and box elder, at \$12 per M feet, were not reported for any other industry in North Carolina. This industry demanded 35,000 feet of ash, which was one-fourth of all reported in the State.

TABLE 10.—SASH, DOORS, BLINDS, AND INTERIOR FINISH (MILL WORK).

KIND OF WOOD.	GROWN IN NORTH CAROLINA.		GROWN OUTSIDE OF NORTH CAROLINA.		TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
North Carolina pine	50,636,000	\$ 12.71	1,000,000	\$ 13.60	51,636,000	\$ 12.90	\$ 666,791.68	12.30
White pine	3,825,000	17.95			3,825,000	17.95	68,273.75	26.90
Yellow poplar	835,000	15.95			835,000	15.95	13,318.25	2.40
Red and white oak	608,000	26.83	90,000	40.00	758,000	28.43	21,556.84	5.52
Chestnut	386,000	17.30			386,000	17.30	6,677.80	5.00
Spruce	150,000	12.50			150,000	12.50	1,875.00	100.00
Basswood	100,000	18.00			100,000	18.00	1,800.00	38.00
Yellow birch	95,000	36.82			95,000	36.82	3,498.55	18.50
Cypress	56,000	16.00	60,000	50.00	60,000	50.00	3,000.00	2.20
Red and tupelo gum					56,000	16.00	896.00	.23
Ash	35,000	42.14			35,000	42.14	1,474.90	2.47
Cottonwood	30,000	12.00			30,000	12.00	360.00	100.00
Cucumber	15,000	12.00			15,000	12.00	180.00	100.00
Box elder	5,000	12.00			5,000	12.00	60.00	100.00
Totals	56,636,000	13.51	1,150,000	17.57	57,686,000	13.60	783,932.77	

CHAIRS.

Table 11 gives statistics of chair manufacturing in North Carolina. From the standpoint of the retail merchant and the consumer chairs are considered furniture, but from the point of view of the manufacturer they are considered separate and distinct. Chairs of practically all kinds are made in North Carolina—reclining chairs, rockers, patent rockers, diners, morris chairs, hall chairs, porch chairs, official chairs for lodge-rooms, and stools of many kinds. Chair stock shipped into the State in a knocked-down condition, to be assembled and finished after its arrival here, was not included in this report, nor was any information turned in from upholstering concerns. See Plates III and IV.

The chair industry is fifth in importance in North Carolina from the standpoint of the amount of wood used, and, as in the case of furniture making, is confined almost exclusively to the Piedmont region. Only 250,000 feet out of a total of 47,325,000 used by chair makers in the State is consumed outside the borders of this region. Seven kinds of woods are reported used in this industry. Oak, of the same species as are used in furniture manufacturing, represents 97 per cent of the total quantity of raw material demanded by this industry. It is one-third of all the oak used by manufacturers in the State. Maple, yellow poplar, and hickory, in the order named, follow oak in quantity used. Only 3 per cent of the chair material is grown outside of the State. Fifty-eight per cent of the chair-making concerns buy a portion of their raw material in the form of rough-sawed squares. This is of importance to mill men, who can make use of waste by sawing it in squares of suitable dimensions.

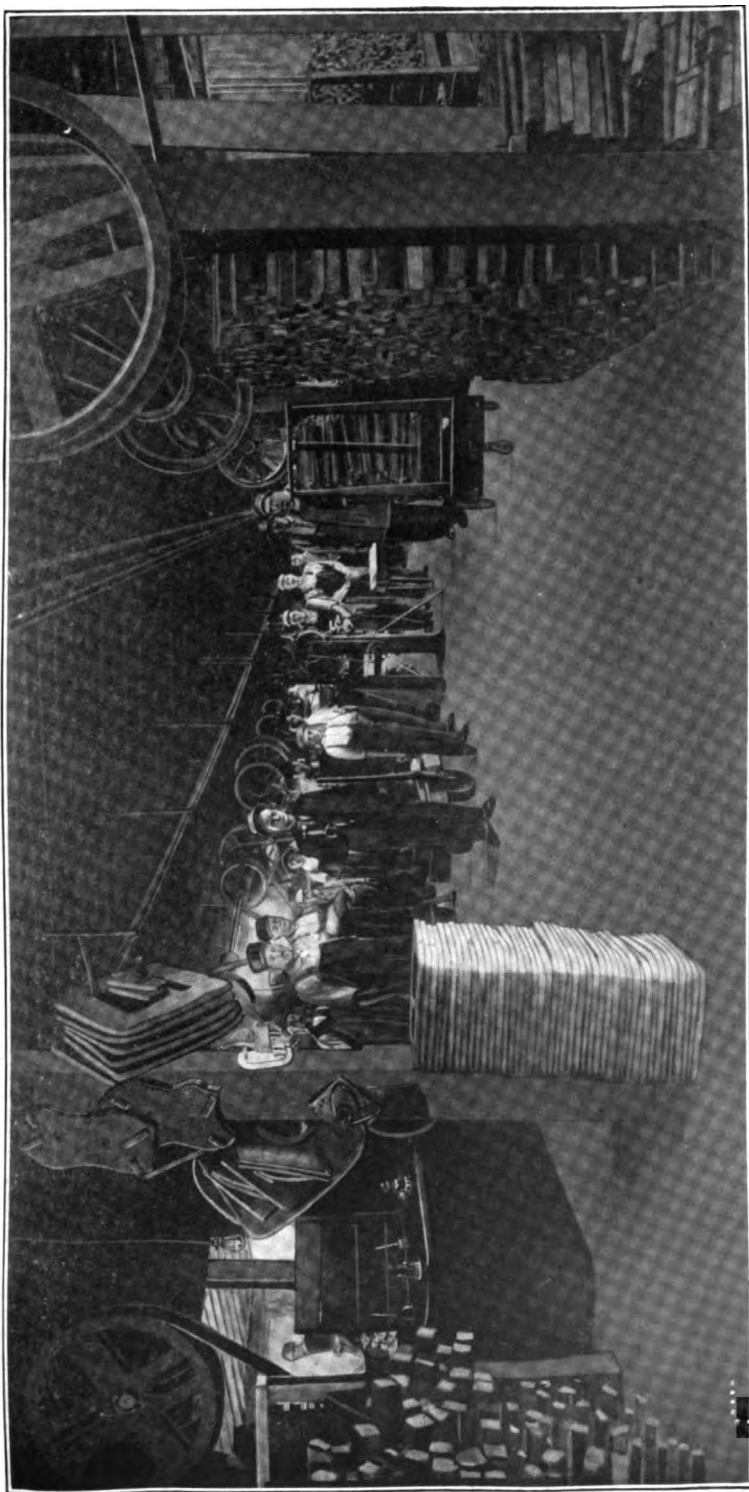


PLATE IV. TURNING ROOM OF THE SOUTHERN CHAIR COMPANY, HIGH POINT, N. C.

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TABLE 11.—CHAIRS, ROCKERS, AND RECLINING CHAIRS.

KIND OF WOOD.	GROWN IN NORTH CAROLINA.			GROWN OUTSIDE OF NORTH CAROLINA.			TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Red, white, chestnut and Spanish oak.....	43,955,000	\$ 17.91	1,150,000	\$ 27.80	45,105,000	\$ 18.16	\$ 819,183.05			31.09
Hard maple.....	830,000	20.23			830,000	20.23	16,790.90			20.20
Yellow poplar.....	475,000	23.27			695,000	24.00	16,653.25			2.00
Hickory.....	585,000	21.70	220,000	25.45	585,000	21.70	12,604.50			5.30
Red gum.....	50,000	12.00			50,000	12.00	600.00			2.1
Birch.....	50,000	22.50			50,000	22.50	1,125.00			9.70
Elm.....	10,000	17.50			10,000	17.50	175.00			5.10
Totals.....	45,955,000	18.05	1,370,000	27.41	47,325,000	18.33	867,221.70			

TABLES.

The manufacture of tables in North Carolina is in itself a large industry, entirely distinct from that of furniture making. Like furniture and chairs, the manufacturers making tables are located mostly in the Piedmont region of the State. Every kind of table from the cheapest for kitchen use to the most elaborately carved parlor and library table is manufactured. Table 12 shows that 31,868,000 feet of lumber, or 5 per cent of the total consumed in manufacturing in the State, were used, at an average cost of \$17.06 per thousand. Red, white, Spanish, and chestnut oak, aggregating 21,947,000 feet, head the list of woods for this industry. The wood is all grown in North Carolina and is 15 per cent of the total oak used by manufacturers in this State. Longleaf and North Carolina pine are next in importance to oak for the manufacture of tables. This, too, was State grown, and 4,520,000 feet were purchased at an average of \$13.14 per thousand. Of the 4,000,000 feet of poplar going into tables, 65 per cent is shipped in from neighboring States, Tennessee furnishing the larger portion of it. The average price for poplar in this industry was \$20.96, which is \$3.76 more than was paid for this wood by furniture manufacturers. Chestnut, which stands next to poplar in quantity, is used mostly for cores in making built-up table tops; 1,000,000 feet was reported, which was 13 per cent of the total chestnut manufactured in North Carolina. The remaining species named in the following table are used in very nominal quantities and range in price from \$16 per M feet for basswood to \$120 per M for mahogany.

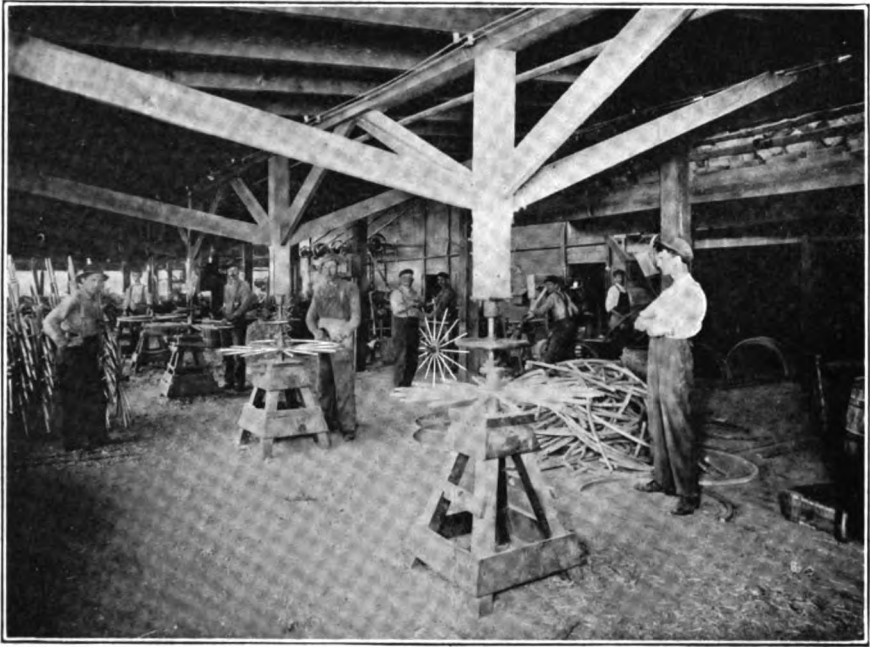
TABLE 12.—TABLES, STANDS, AND EXTENSION TABLES.

KIND OF WOOD.	GROWN IN NORTH CAROLINA.		GROWN OUTSIDE OF NORTH CAROLINA.		TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Red, white, Spanish and chestnut oak	21,947,000	\$ 17.73	50,000	\$ 30.00	21,947,000	\$ 17.13	\$ 375,952.11	15.13
North Carolina pine	4,470,000	12.96	2,600,000	22.55	4,520,000	13.14	59,431.20	1.00
Yellow poplar	1,465,000	18.57			4,065,000	20.96	85,830.15	11.60
Chestnut	1,000,000	17.20			1,000,000	17.20	17,200.00	12.90
Ash	100,000	17.00			100,000	17.00	1,700.00	7.06
Basswood	100,000	16.00			100,000	16.00	1,600.00	38.00
Red gum	51,000	20.00			51,000	20.00	1,020.00	.21
Maple	50,000	20.00			50,000	20.00	1,000.00	1.20
Birch	2,000	24.00			2,000	24.00	48.00	.40
Cherry	2,000	24.00			2,000	24.00	48.00	6.90
Mahogany			1,000	120.00	1,000	120.00	120.00	1.60
Totals	28,217,000	16.57	2,651,000	22.72	31,868,000	17.06	543,939.46	

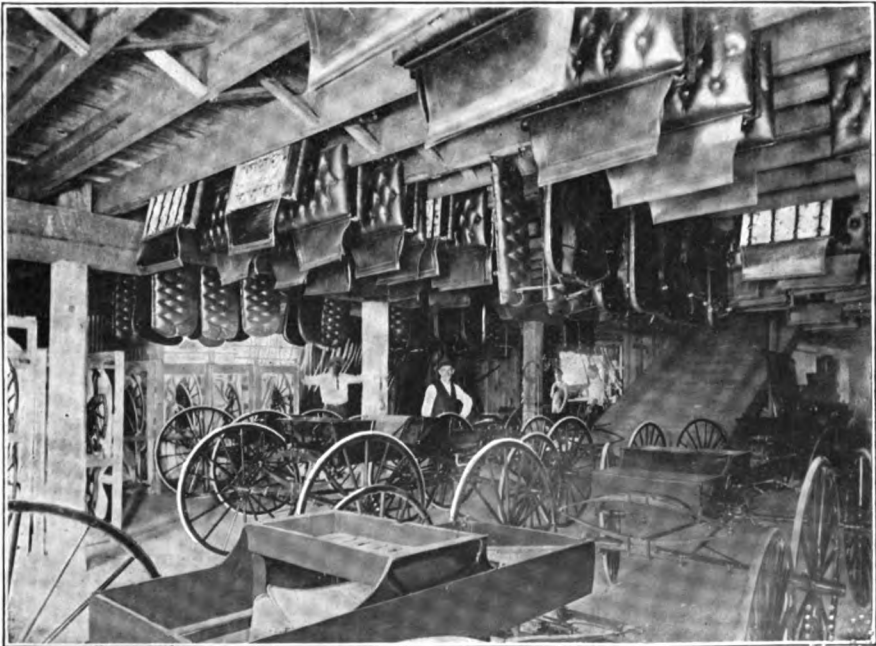
VEHICLES.

Vehicles of all kinds are included in this industry, from the finest finished carriage and phaeton down to the dump-cart and the logging truck. Table 13 does not represent the full amount of material consumed in the manufacture of vehicles in North Carolina, though it comprises a very large percentage. In every village, town, and city of the State there are wagon makers who turn out a few vehicles in the course of the year, but whose chief work is repairing. A large quantity of wood is used. An effort was made to include all, but lack of information as to the exact locations of many, and the indifference of others to the work, and their ignoring requests for information, made the collecting of this data more difficult than for any other industry. The convenience of being near the source of supply has attracted to North Carolina large manufacturers of vehicles. See Plate V, A and B.

A number of the manufacturers of vehicles in this State merely assemble the component parts and put on the finishing touches. Information from this class, as stated before, was not solicited. The data furnished by the manufacturers of hubs, rims, spokes, bodies, axles, etc., together with the amount of raw material used by those industries which make the vehicle in all its parts, are shown in Table 13. Eight woods are listed, and hickory leads the list in quantity, being 60 per cent of all the hickory reported in the State. Forty-four per cent of the vehicle wood grew outside the State, no other industry reporting so large a percentage of its material. Tough, strong woods are essential, and this accounts for the fact that average prices paid by vehicle makers for their woods were above those in any other industry. High grades of lumber were demanded. In this connection it is worthy of note that 88 per cent of the manufacturers listed under this industry purchased their material in established grades, which was above the percentage of any other industry.



A. INTERIOR VIEW OF WHEEL FACTORY OF HIGH POINT BUGGY COMPANY,
HIGH POINT, N. C.



B. INTERIOR VIEW OF PACKING DEPARTMENT OF HIGH POINT BUGGY COMPANY,
HIGH POINT, N. C.

1900

TABLE 13.—TRUCKS, VEHICLES, AND WAGONS.

KIND OF WOOD.	GROWN IN NORTH CAROLINA.			GROWN OUTSIDE OF NORTH CAROLINA.			TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Hickory.....	1,440,000	\$ 34.43	5,145,000	\$ 28.93	6,585,000	\$ 29.08	6,585,000	\$ 29.08	191,532.10	60.00
White oak.....	3,260,000	26.40	1,025,000	22.63	4,285,000	25.50	4,285,000	25.50	109,314.00	3.00
Yellow poplar.....	1,404,000	29.80	655,000	31.29	2,059,000	30.32	2,059,000	30.32	62,336.69	5.80
North Carolina pine.....	1,431,000	18.12	25,000	20.00	1,456,000	18.29	1,456,000	18.29	26,429.72	40
White ash.....	884,000	27.88	10,000	30.00	894,000	27.88	894,000	27.88	25,045.92	63.10
Red gum.....	250,000	18.30			250,000	18.30	250,000	18.30	4,575.00	1.03
Elm.....	87,000	20.00			87,000	20.00	87,000	20.00	1,740.00	44.10
Hard maple.....	20,000	15.00			20,000	15.00	20,000	15.00	300.00	50
Totals.....	8,776,000	25.96	6,860,000	28.19	15,636,000	26.30	15,636,000	26.30	421,273.43	-----

FRUIT AND VEGETABLE PACKAGES.

The products of this industry comprise baskets and packages in which fruit and vegetables are shipped and marketed. The growing custom of selling provisions to the consumer in individual packages has in recent years increased the importance of this industry in North Carolina. The commodities are grape baskets, fruit baskets, berry cups, vegetable cups, hoppers, barrels (veneer), and vegetable crates, and the business of making them is confined to the Coastal region, where truck farming and fruit growing is a thriving and rapidly-growing industry.

The raw material is delivered to the basket maker in log form, and this accounts for the low price paid as compared with the other industries. The price was \$7.65 per M feet log scale, and was the lowest reported by any of the twenty-one industries. It was 66 cents lower than the price paid by excelsior makers, who buy their wood in the forms of billets and poles.

Six kinds of wood were reported, as shown in Table 14. The first process of manufacture consists in converting the logs into sheets of veneer, and a further process finishes the articles. The cores which remain after the veneer is cut from the logs are largely sawed into thin lumber and utilized for the covers and bottoms of barrels, hoppers, baskets, etc., and for making light vegetable crates.

In the quantity of wood consumed this class of manufacturers stands seventh on the list of North Carolina's wood-using industries, while in the amount of money paid for raw material it ranks ninth on the list.

All of the wood used is grown in the State, and in board measure amounts to 8,862,000 feet. Red and tupelo gum, the former being more extensively employed, head the list for quantity. More red gum is cut into veneers than any other wood, and a large percentage of it goes into baskets, crates, and packages. North Carolina pine is second on the list in the quantity used. As in the case of boxes, large sawmills often manufacture fruit and vegetable packages as a side line.

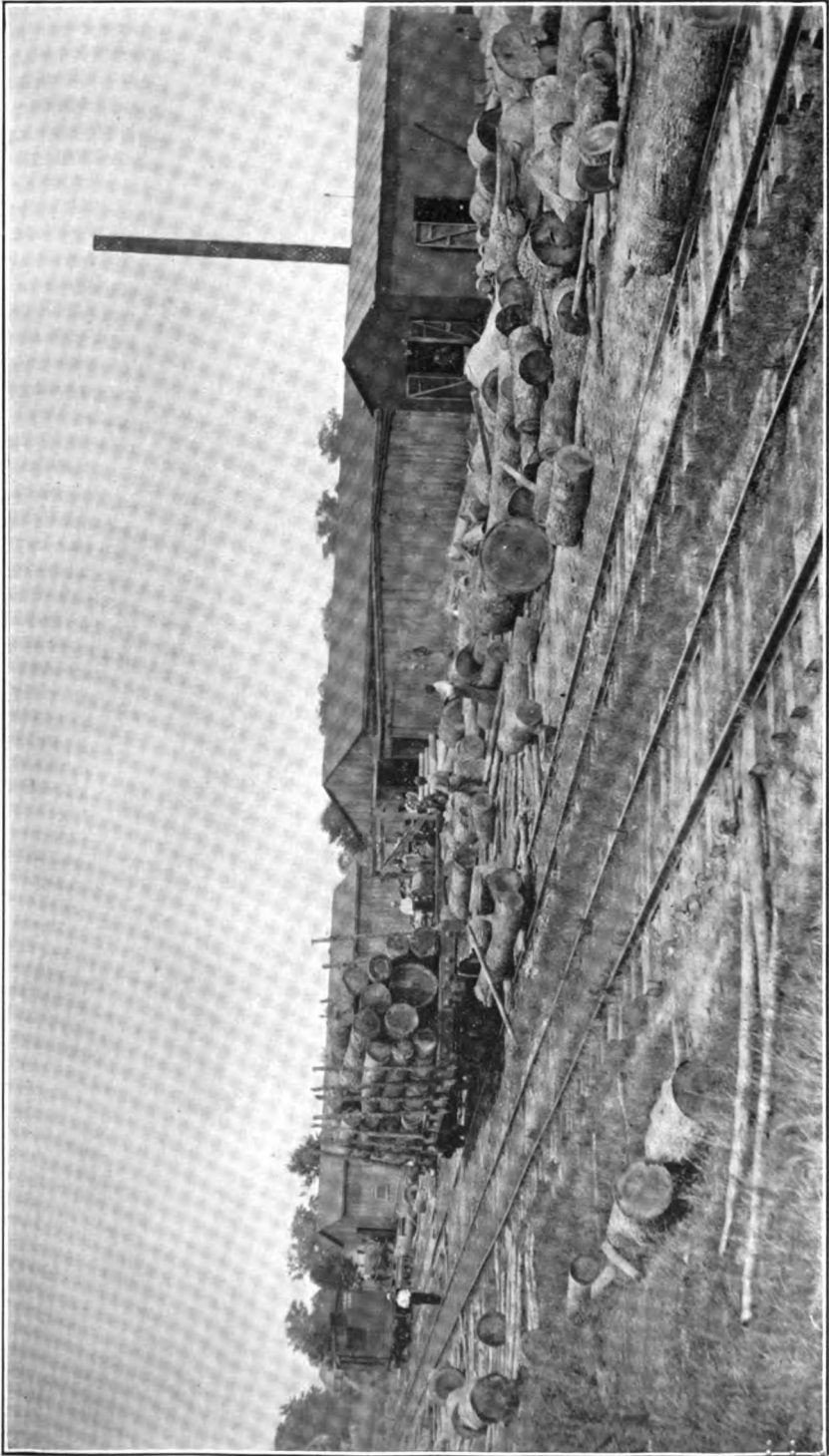


PLATE VI. MILL AND YARD OF THE WILKES VENEER COMPANY, EDENTON, N. C.

TABLE 14.—FRUIT AND VEGETABLE PACKAGES.

KIND OF WOOD.	GROWN IN NORTH CAROLINA.			GROWN OUTSIDE OF NORTH CAROLINA.			TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Red and tupelo gum.....	6,180,000	\$ 7.67		\$.....	6,180,000	\$ 7.67	6,180,000	7.67	\$ 47,400.60	25.35
North Carolina pine.....	2,020,000	7.26		.....	2,020,000	7.26	2,020,000	7.26	14,665.20	7.50
Yellow poplar.....	382,000	8.64		.....	382,000	8.64	382,000	8.64	3,489.68	1.03
Maple.....	150,000	8.00		.....	150,000	8.00	150,000	8.00	1,200.00	4.00
Elm.....	100,000	7.00		.....	100,000	7.00	100,000	7.00	700.00	50.80
Sycamore.....	50,000	7.00		.....	50,000	7.00	50,000	7.00	350.00	13.60
Totals.....	8,882,000	7.65		.....	8,882,000	7.65	8,882,000	7.65	\$ 67,805.48	

INSULATOR PINS AND BRACKETS.

Makers of insulator pins and brackets bought all their wood in North Carolina. This industry stands ninth on the list for quantity of material consumed. Only three woods are reported, white and chestnut oak, and yellow locust. The 3,000,000 feet of oak utilized is 2 per cent of the total amount of this kind of wood used in this State. The average price per M feet paid is less than that reported for this wood by any other industry. This is because raw material for making insulator pins is bought as logs and bolts. The yellow locust recorded in Table 15 constitutes the whole of this wood reported in the State, and the amount consumed was 2,600,000 feet, the price paid being \$14 per thousand feet.

TABLE 15.—INSULATOR PINS AND BRACKETS.

KIND OF WOOD.	RAW MATERIAL USED ANNUALLY, AND GROWN IN NORTH CAROLINA.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
White and chestnut oak.....	3,000,000	\$ 5.00	\$ 15,000.00	2.06
Yellow locust.....	2,600,000	14.00	36,400.00	100.00
Totals.....	5,600,000	9.18	51,400.00	

COFFINS, CASKETS, AND CASKET CASES.

Notwithstanding that many of the coffins and caskets sold in North Carolina are manufactured elsewhere, this industry stands tenth on the list in quantity of lumber used, the amount being 5,000,000 feet annually, at an average cost of \$17.09 per M. This is one of only eight industries considered in this report which pays more than an average of \$17 per M feet for raw material. North Carolina pine is highest in quantity used, as is shown in Table 16, which records the use of seven other woods. More than 10 per cent of the pine is grown outside of the State, and is reported shipped from South Carolina. This industry paid 73 cents more for yellow pine than was paid by the makers of sash, doors, and blinds, and \$1.26 more than the average paid by the manufacturers of floor, ceiling, and siding. North Carolina pine is used in making all the products of this industry, while chestnut, following next in importance, is utilized only for making caskets. The total chestnut used was 1,300,000 feet, which was 17 per cent of all the chestnut manufactured in North Carolina. The sound wormy is the grade most commonly desired. The average price of this delivered at the fac-

TABLE 16.—COFFINS, CASKETS, AND CASKET CASES.

KIND OF WOOD.	GROWN IN NORTH CAROLINA.			GROWN OUTSIDE OF NORTH CAROLINA.			TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
North Carolina pine.....	1,899,000	\$ 13.48	200,000	\$ 15.00	2,099,000	\$ 13.63	2,099,000	\$ 13.63	\$ 28,610.02	50
Chestnut.....	1,300,000	18.00			1,300,000	18.00	1,300,000	18.00	23,400.00	16.80
White pine.....	595,000	22.02			595,000	22.02	595,000	22.02	13,143.55	4.50
Yellow poplar.....	455,000	18.53	100,000	24.00	555,000	19.51	555,000	19.51	10,831.15	1.00
Red cedar.....	125,000	25.00			125,000	25.00	125,000	25.00	3,125.00	86.20
Black walnut.....	50,000	31.60			50,000	31.60	50,000	31.60	1,580.00	8.50
Cypress.....	11,000	10.00	40,000	20.00	51,000	20.00	40,000	20.00	800.00	1.40
White oak.....					11,000	10.00	11,000	10.00	110.00	.008
Totals.....	4,435,000	17.03	340,000	18.00	4,775,000	17.09	4,775,000	17.09	\$ 81,599.72	

tory is \$18 per M feet. All the chestnut used was State grown. Higher grades of white pine are demanded by this industry than by any other in the State, and its average price was \$22.02, while the price paid by the sash, door, and blind manufacturers was only \$17.95. Of the poplar consumed by the coffin and casket makers, 20 per cent is grown outside of the State, and comes from Tennessee. Red cedar is used for manufacturing both coffins and caskets, while black walnut is used only for coffins. The prices paid for these two species are higher than any of the others in this industry. Black walnut averaged \$31.60 per M feet, and red cedar \$25.

HANDLES.

The kinds of handles manufactured by this industry in North Carolina are, axe, pick, maul, sledge, hammer, tool, and machinery. Hickory alone is used in the making of these handles, being the only available wood possessing the necessary qualities of flexibility and strength. As shown in Table 17, the handle makers consume 3,595,000 feet annually. This is purchased in the form of bolts and billets, and represents one-third of the hickory used in manufacture in the State. All of this material was grown in North Carolina, and its average price was \$17.30 per thousand feet.

TABLE 17.—AXE, TOOL, AND MACHINERY HANDLES.

KIND OF WOOD.	RAW MATERIAL USED ANNUALLY, AND GROWN IN NORTH CAROLINA.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Hickory.....	3,595,000	\$ 17.30	\$ 62,193.50	32.60

SHUTTLES, SPOOLS, BOBBINS, ETC.

Statistics of this industry include shuttles, spools, bobbins, skewers, and picker-sticks. These articles are not all made in the same factories, but they have been grouped together for convenience of compilation. The raw material was purchased in the form of logs, bolts, billets, and sawed squares. The average prices given in the table are for so many forms and sizes that they are of little value for comparison and study. Seven woods were reported, the list being headed by maple, which totaled 2,160,000 feet. Dogwood and persimmon were reported for this industry alone, and are used almost exclusively in making shuttles. Dogwood stands second on the list in quantity. Two per cent of the hickory used in the State goes into the products of this industry, principally

into skewers and picker-sticks. The birch is manufactured into bobbins, spools, skewers, and picker-sticks. Thirty-one per cent of all the birch manufactured in the State, and 38 per cent of the beech go into these articles.

TABLE 18.—SHUTTLES, BOBBINS, SPOOLS, AND SKEWERS.

KIND OF WOOD.	RAW MATERIAL USED ANNUALLY, AND GROWN IN NORTH CAROLINA.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Maple.....	2,160,000	\$ 15.14	\$ 32,702.40	53.08
Dogwood.....	600,000	18.75	11,250.00	100.00
Hickory.....	240,000	28.13	6,751.20	2.20
Birch.....	160,000	16.25	2,600.00	31.20
Persimmon.....	150,000	20.00	3,000.00	100.00
Yellow poplar.....	110,000	10.47	1,151.70	.31
Beech.....	60,000	10.00	600.00	38.70
Totals.....	3,480,000	16.63	56,055.30	

FARMING IMPLEMENTS.

The manufacturers of farming implements report using 3,391,000 feet of lumber annually, which is one-half of 1 per cent of the total consumed by all the manufacturers in the State in 1909. Only four woods are reported—gum, oak, and white and yellow pine. Seventy-three per cent was red and tupelo gum, which was 10 per cent of all the gum manufactured in the State. Oak is next in quantity used by these manufacturers, red oak, white oak, and post oak being reported. The average cost per M feet was \$20.18, which was higher than the price paid for oak by the furniture, chair, and table manufacturers. North Carolina pine stands third on the list, being less than 10 per cent of the wood used in this industry. The average price for white pine was \$54 per M feet, which was the highest price reported in the State for American woods. Table 19 below presents the available statistics:

TABLE 19.—FARMING IMPLEMENTS.

KIND OF WOOD.	RAW MATERIAL USED ANNUALLY, AND GROWN IN NORTH CAROLINA.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Red and tupelo gum.....	2,500,000	\$ 10.00	\$ 25,000.00	10.26
Red, white and water oak.....	546,000	20.18	11,018.38	.37
North Carolina pine.....	335,000	11.87	3,976.45	.08
White pine.....	10,000	54.00	540.00	.08
Totals.....	3,391,000	11.95	40,534.83	

KITCHEN SAFES.

This is the third subdivision of furniture classified in this study as a distinct industry. It includes cupboards, safes, and cabinets. A cabinet is a kind of safe whose space is ingeniously divided up into many compartments, providing a convenient place for provisions usually kept on hand in the kitchen, such as flour, sugar, meal, salt, coffee, etc. This class of furniture is more cheaply manufactured than articles for living-rooms and parlors, and it does not require the skill of highly trained workmen, nor the best grades of lumber for its manufacture. Oak is the principal wood used, and averages in price only \$11.39 per M, while the oak from which chairs and tables are made was reported at a cost of \$18.16 and \$17.13 per M, respectively. The quantity of yellow poplar used was 1,575,000 feet, that being only 75,000 feet less than the quantity of oak used. It was all grown in North Carolina, making this the only industry considered in this study in which all of the poplar used was grown in the State. The average price for this kind of wood was \$18.67 per M, which was \$1.47 higher than the price paid by the furniture makers. The oak is mostly used for the outside work of safes, cabinets, and cupboards, while poplar is utilized for inside work, such as shelvings, partitions, etc., and for both inside and outside work of the cabinets. The chestnut was of the sound wormy grade, a limited quantity only being used in 1909. The cost is about the average reported by other industries for this kind of wood. It is all grown in North Carolina.

TABLE 20.—KITCHEN SAFES, CABINETS, AND CUPBOARDS.

KIND OF WOOD.	RAW MATERIAL USED ANNUALLY, AND GROWN IN NORTH CAROLINA.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Red, white, post and Spanish oak	1,650,000	\$ 11.39	\$ 18,793.50	1.13
Yellow poplar.....	1,575,000	18.67	29,405.25	4.50
Chestnut.....	100,000	15.00	1,500.00	1.30
Totals.....	3,325,000	14.95	49,698.75	.....

CROSS-ARMS.

The making of cross-arms for telegraph and telephone poles is a very simple operation. It consists merely in shaping into form, by the use of machinery, the raw material purchased in the form of squares of the proper size, and by boring holes for insulator pins. North Carolina pine is the only wood reported for these products. The average price

paid was \$14.66 per M, or \$2.55 above the average cost of this wood used in the State by all manufacturers. The total was 2,800,000 feet, and was less than three-fourths of 1 per cent of all the yellow pine manufactured by the wood-using industries of North Carolina.

TABLE 21.—CROSS-ARMS (TELEPHONE AND TELEGRAPH).

KIND OF WOOD.	RAW MATERIAL USED ANNUALLY, AND GROWN IN NORTH CAROLINA.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
North Carolina pine.....	2,816,000	\$ 14.66	\$ 41,282.54	.7

PIPES, MINE ROLLERS, AND PULLEYS.

Table 22 shows a practical use for black gum, which until recently was considered of little value for manufacturing purposes. It is cheaper than maple and has largely displaced it for the manufacture of mine rollers, and is used with red gum in making pulleys. The annual quantity of black gum used in North Carolina for making these products is 2,500,000 feet, reported at an average price of \$8.36 per M. This is the only class of manufacturers in the State reporting black gum as a raw material.

Pipes have been classified under this industry for convenience of tabulation, but have no relation to mine rollers and pulleys. These are smoking pipes and are articles made of the root of the kalmia, which is better known as mountain laurel. The laurel comes to the factory in the form of roots and burls, and costs about 25 cents per hundred pounds at the factory, which, reduced to the basis of board measure, makes the price paid approximately \$10 per M feet, board measure.

TABLE 22.—PIPES, PULLEYS, AND MINE ROLLERS.

KIND OF WOOD.	RAW MATERIAL USED ANNUALLY, AND GROWN IN NORTH CAROLINA.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Black gum.....	2,500,000	\$ 8.36	\$ 20,900.00	100.00
Kalmia.....	22,000	10.00	220.00	100.00
Red gum.....	10,000	12.00	120.00	.04
Totals.....	2,532,000	8.39	21,240.00	

STORE AND OFFICE FIXTURES, MANTELS, ETC.

There is a class of work for inside trim for buildings which is of a higher grade than described under sash, doors, blinds, etc., and consists chiefly of carved moldings, mantels, grills, and cabinets. Twenty-two woods are used, as shown in Table 23, and it is the largest list of woods reported by any industry in North Carolina. Highest grades of lumber are used, and it is due to this fact that the manufacturers of fixtures pay more for their raw material than is paid by any other of the woodworking industries. The cheapest wood reported was hemlock at \$12 per M feet, while Circassian walnut was the most expensive at \$200.

Furniture makers paid \$26.71 per M more for mahogany than was paid by this industry. Twenty per cent of the lumber used was grown outside of the State. The average price of the home-grown wood was \$5.42 less per thousand feet than of that shipped in from other States. Hemlock, buckeye, butternut, and Circassian walnut are not reported used in any other industry.

TABLE 23.—STORE AND OFFICE FIXTURES, MANTELS, AND CABINETS.

KIND OF WOOD.	GROWN IN NORTH CAROLINA.		GROWN OUTSIDE OF NORTH CAROLINA.		TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.		Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	
Red and white oak.....	812,000	\$ 40.03	60,000	\$ 60.00	872,000	\$ 41.40	.61
North Carolina pine.....	2,000	20.00	300,000	12.50	302,000	12.54	.07
Red and tupelo gum.....	260,000	29.42			260,000	29.42	1.07
Yellow poplar.....	217,000	32.41	15,000	20.00	232,000	32.41	.66
White pine.....	140,000	31.96			140,000	31.96	1.07
Chestnut.....	115,000	19.30			115,000	19.30	1.50
Yellow birch.....	80,000	42.18			80,000	42.18	15.60
Maple.....	80,000	31.50			80,000	31.50	1.20
Black walnut.....	21,000	66.13	10,000	70.00	31,000	66.43	6.90
Basewood.....	40,000	40.00			40,000	40.00	15.00
Ash.....	30,000	25.00			30,000	25.00	2.12
Cherry.....	27,000	55.00			27,000	55.00	93.10
Hemlock.....	25,000	12.00			25,000	12.00	100.00
Manokany.....	20,000	40.00	24,000	132.50	44,000	132.50	37.30
Beech.....	20,000	40.00			20,000	40.00	12.90
Red cedar.....	20,000	40.00			20,000	40.00	13.80
Hickory.....	20,000	40.00			20,000	40.00	18.18
Butternut.....	20,000	40.00			20,000	40.00	100.00
Cypress.....			15,000	30.00	15,000	30.00	.54
Sycamore.....			15,000	20.00	15,000	20.00	300.00
Buckeye.....					10,000	40.00	4.07
Circassian walnut.....	10,000	40.00			10,000	40.00	100.00
All others*.....			3,000	200.00	3,000	200.00	100.00
			3,000	80.00	3,000	80.00	100.00
Totals.....	1,919,000	35.53	445,000	30.11	2,364,000	34.52	81,607.67

*Includes only imported woods not mentioned.

MUSICAL INSTRUMENTS.

Seven woods are listed in the manufacture of musical instruments, as shown in Table 24. High-grade oak and black walnut, in equal quantities, head this list. Eighty-four per cent of the black walnut manufactured in North Carolina goes into musical instruments, and 54 per cent of the sycamore is so used. White pine is reported at the low price of \$12 per M, its chief use being for crating material and organ boxes. Next to vehicle manufacture, musical instruments draw the largest comparative quantity of their wood from forests outside of North Carolina. The products are not varied, reed organs, cabinet organs, and pipe organs alone being manufactured.

TABLE 24.—MUSICAL INSTRUMENTS.

KIND OF WOOD.	GROWN IN NORTH CAROLINA.		GROWN OUTSIDE OF NORTH CAROLINA.		TOTAL QUANTITY OF RAW MATERIAL USED ANNUALLY.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
Red and white oak	500,000	\$ 22.50			500,000	\$ 22.50	\$ 11,250.00	.34
Black walnut	100,000	40.00	400,000	40.00	500,000	40.00	20,000.00	84.60
Yellow poplar	300,000	20.00			300,000	20.00	6,000.00	.85
Sycamore	200,000	10.00			200,000	10.00	2,000.00	54.20
Chestnut			200,000	20.00	200,000	20.00	4,000.00	2.60
White pine	100,000	12.00			100,000	12.00	1,200.00	.76
Totals	1,200,000	20.38	600,000	33.33	1,800,000	24.70	44,450.00	-----

PLANKING FOR BOATS.

White cedar is more in demand by the builders of boats and launches, to be used as planking or siding, than any other wood required for that purpose. In North Carolina the stand of white cedar, from which this commodity can be manufactured, is being rapidly exhausted. Accordingly, this industry has become entirely a side line, the white-cedar shingle manufacturers producing all the boat planking made in North Carolina in 1909. The average price of cedar as given in Table 25 was \$14.38. This being reported in terms of "log scale" indicates the high price this commodity brings on the market in a manufactured state. Shingles are not considered in this report, owing to their being included with cooperage stock, cross-ties, etc., in the annual report issued by the Bureau of Census in coöperation with the Forest Service. Exclusive of the material used for making shingles, therefore, 76 per cent of the white cedar going into manufactures in this State is utilized for boat siding.

TABLE 25.—BOAT PLANKING.

KIND OF WOOD.	RAW MATERIAL USED ANNUALLY, AND GROWN IN NORTH CAROLINA.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
White cedar.....	800,000	\$ 14.38	\$ 11,504.00	76.2

EXCELSIOR.

Only three woods are reported in Table 26 for making excelsior in North Carolina—yellow poplar, white pine, and yellow pine, named in the order of quantity used. The total amount manufactured was 800,000 feet, purchased at an outlay of \$6,352. The average price paid for this raw material was \$8.30 per M feet, delivered at the factory in the form of billets and poles. The following table presents the available statistics for 1909:

TABLE 26.—EXCELSIOR.

KIND OF WOOD.	RAW MATERIAL USED ANNUALLY, AND GROWN IN NORTH CAROLINA.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
White pine.....	300,000	\$ 6.34	\$ 1,902.00	2.29
Yellow poplar.....	300,000	10.00	3,000.00	.85
Yellow pine.....	200,000	7.25	1,450.00	.05
Totals.....	800,000	8.31	6,352.00	

WOODENWARE.

Candy, well, and water buckets, pails, tubs of various kinds, chop bowls, firkins, churns, ironing boards, bread boards, washboards, and other articles pertaining to household use are the principal products of the woodenware manufacturers of North Carolina. Six kinds of woods were reported at an average price of \$17 per M. A total of 775,000 feet were manufactured, all grown in North Carolina. This industry uses less raw material than any other considered in this study. White cedar, which in North Carolina is commonly but improperly called juniper, headed the list in amount used, and it constituted 24 per cent of the wood demanded by this industry. The white poplar and white cypress noted in the table are known to the local trade by these names, but are in fact only the sapwood of yellow poplar and red cypress. They were recorded in this individual table by these local names in order to indicate to any one desiring to sell raw material for this class of manufactures the kind of wood desired. White cypress is used for confectionery buckets and other packages. It is especially demanded for this purpose, as experience has shown that this wood imparts no taste to the contents of the package. White ash is used for butter tubs and firkins, and 7 per cent of this wood manufactured in the State goes into these products.

TABLE 27.—WOODENWARE.

KIND OF WOOD.	RAW MATERIAL USED ANNUALLY, AND GROWN IN NORTH CAROLINA.			Percentage of Quantity Required by All Industries in State.
	Quantity, Feet b. m.	Average Cost per M bd. ft. Delivered at Factory.	Total Cost Delivered at Factory.	
White cedar.....	250,000	\$ 20.00	\$ 5,000.00	23.80
Yellow poplar.....	100,000	15.00	1,500.00	28
(White) poplar.....	100,000	12.00	1,200.00	100.00
White ash.....	100,000	20.00	2,000.00	7.08
(White) cypress.....	100,000	15.00	1,500.00	100.00
White oak.....	100,000	15.00	1,500.00	.07
White pine.....	25,000	18.00	450.00	.19
Totals.....	775,000	17.00	13,150.00	

APPENDIX I.

USES OF THE DIFFERENT KINDS OF WOOD.

Some of the various uses for the many kinds of wood entering into manufacture in North Carolina are given in the list which follows.

ASH.

Axles,
Buckets,
Buggy bodies,
Felloes (Wagon),
Furniture,
Gears (Running),
Interior trimming,
Measures,
Tables (Dining),
Tables (Extension),
Tops (Wagon),
Wagons,
Woodenware.

BASSWOOD.

Cabinet work,
Fixtures (Office),
Fixtures (Store),
Furniture,
Interior trimming,
Tables,
Tables (Extension).

BEECH.

Bobbins,
Cabinet work,
Fixtures (Office),
Fixtures (Store),
Furniture,
Interior trimming,
Mantels,
Shuttles,
Skewers,
Spools.

BIRCH.

Bobbins,
Chairs,
Furniture,
Interior trimming,
Moldings (Fancy),
Rockers,
Showcases,
Skewers,
Stands,
Tables (Extension).

BLACK GUM.

Back bands,
Baskets,
Baskets (Fruit),

Baskets (Vegetable),
Cases (Berry),
Cases (Fruit),
Cases (Vegetable),
Crates (Vegetable),
Cases (Berry),
Cups (Quart),
Hoppers,
Implements (Agricultural),
Rollers (Log wagon),
Rollers (Mine),
Slack cooperage,
Trays.

BLACK AND YELLOW LOCUST.

Brackets (Pole),
Insulator pins.

BLACK WALNUT.

Cabinet work,
Coffins,
Fixtures (Bar),
Fixtures (Office),
Fixtures (Store),
Organs (Pipe),
Organs (Reed),
Showcases.

BOX ELDER.

Interior trimming.

BUCKEYE.

Cabinet work,
Fixtures (Office).

BUTTERNUT.

Cabinet work,
Fixtures (Office),
Fixtures (Store),
Furniture (Inside of).

CIRCASSIAN WALNUT.

Cabinet work,
Fixtures (Office),
Fixtures (Store),
Interior trimming,
Moldings (Fancy).

CHERRY.

Cabinet work,
Fixtures (Office),

Fixtures (Store),
Furniture,
Interior trimming,
Mantels,
Moldings (Fancy),
Panels,
Pedestals,
Showcases,
Stands,
Tables (Library),
Tables (Parlor).

CHESTNUT.

Blocks (Base),
Blocks (Corner),
Boards (Wash),
Cabinet work,
Caskets,
Coffins,
Cradles,
Exterior trimming,
Fixtures (Office),
Fixtures (Store),
Flooring,
Furniture,
Furniture (Mission),
Interior trimming,
Mantels,
Moldings (Stock),
Organs (Pipe),
Organs (Reed),
Panels,
Partition,
Pedestals,
Showcases,
Stair work,
Stands,
Tables,
Tables (Dining),
Tables (Library),
Tables (Sewing).

COTTONWOOD.

Interior trimming.

CUCUMBER.

Interior trimming.

DOGWOOD.

Bobbins.

ELM.

Baskets,
Baskets (Grape),
Baskets (Fruit),
Chairs,
Crates,
Hoppers,
Rockers,
Tops (Buggy),
Trays.

HARD MAPLE.

Bobbins,
Cabinet work,
Chairs,
Chairs (Reclining),
Desks (School),
Flooring,
Frames (Wagon bed),
Frames (Buggy box),
Furniture,
Moldings (Stock),
Panels,
Pedestals,
Piano stools,
Rockers,
Skewers,
Spools,
Stands,
Sticks (Picker),
Tables.

HEMLOCK.

Fixtures (Office).
Fixtures (Store).
Interior trimming.

HICKORY.

Axles,
Bobbins,
Buggies,
Carriages,
Carts,
Casing (Axle),
Chairs,
Fixtures (Office).
Fixtures (Store),
Handles (Axe).
Handles (Machinery),
Handles (Tool),
Picker sticks,
Rims,
Rockers,
Shuttles,
Singletrees,
Skewers,
Spokes,
Shafts,
Sulkies,
Trucks,
Wagons,
Wheels.

KALMIA.

Holders (Cigar),
Pipes (Tobacco).

MAHOGANY.

Cabinets (Music),
Cabinet work,
Fixtures (Office),
Fixtures (Store),
Furniture,

Interior trimming,
 Mantels,
 Moldings (Fancy),
 Panels,
 Pedestals,
 Stands,
 Showcases,
 Tables (Extension),
 Tables (Library),
 Tables (Parlor),
 Tables (Serving),
 Tables (Sewing).

NORTH CAROLINA PINE.

Balusters,
 Baskets,
 Blinds,
 Boxes,
 Boxes (Rough),
 Brackets,
 Buggy bodies,
 Cabinet works,
 Car siding,
 Carriage bodies,
 Casing,
 Caskets,
 Ceiling,
 Coffins,
 Corner strips,
 Cornice work,
 Crates (Vegetable),
 Crates (Fruit),
 Cross-arms,
 Cultivators,
 Diggers,
 Door frames,
 Doors,
 Doors (Front),
 Excelsior,
 Factory flooring,
 Fixtures (Store),
 Fixtures (Office),
 Flooring,
 Furniture,
 Grill work,
 Hand rails,
 Harrows,
 Hoppers,
 Interior trimming,
 Mantels,
 Newel posts,
 Organs,
 Panels,
 Partition,
 Planters,
 Plows,
 Poles,
 Porch columns,
 Sashes,
 Seeders,
 Shooks (Box),
 Showcases,
 Siding,

Slack cooperage,
 Stair work,
 Stock novelties,
 Store fronts,
 Spindles,
 Window frames.

PERSIMMON.

Bobbins,
 Shuttles,
 Skewers.

POST OAK.

Brackets (Telephone pole),
 Chairs,
 Cupboards (Kitchen),
 Doors,
 Furniture,
 Implements (Farming),
 Interior trimming,
 Safes (Kitchen),
 Showcases,
 Slack cooperage,
 Tables,
 Tables (Kitchen).

RED CEDAR.

Boxes (Clothes),
 Casket snells,
 Caskets,
 Furniture,
 Interior trimming,
 Shingles.

RED CYPRESS.

Base blocks,
 Base boards,
 Casing,
 Doors,
 Exterior trimming,
 Flooring,
 Interior trimming,
 Molding (Stock),
 Partition,
 Sash,
 Shingles,
 Washboards.

RED OAK.

Agricultural implements,
 Base blocks,
 Bedroom suits,
 Brackets,
 Brackets (Telegraph),
 Brackets (Telephone),
 Buffets,
 Bureaus,
 Cabinet work,
 Cabinets (Kitchen),
 Cabinets (Wall),
 Cabinets (Parlor).

Cabinets (China),
 Chairs,
 Chairs (Reclining),
 Chiffoniers,
 Cradles,
 Cultivators,
 Cupboards,
 Davenportes,
 Desks,
 Doors,
 Doors (Front),
 Dressers,
 Fixtures (Office),
 Fixtures (Store),
 Flooring,
 Furniture,
 Harrows,
 Hall racks,
 Interior trimming,
 Lamp stands,
 Lounges,
 Mantels,
 Moldings (Stock),
 Organs (Pipe),
 Organs (Reed),
 Partition,
 Pedestals,
 Piano stools,
 Piano benches,
 Planters,
 Plows,
 Rockers,
 Safes (Kitchen),
 Secretaries,
 Seeders,
 Showcases,
 Sideboards,
 Slack cooperage,
 Sofas,
 Stands,
 Stair work,
 Washboards.

RED AND TUPELO GUM.

Base boards,
 Baskets (Grape),
 Baskets (Fruit),
 Baskets (Vegetable),
 Baskets (Split),
 Boxes (Berry),
 Boxes (Plug tobacco),
 Buggy bodies,
 Cabinet work,
 Cases (Berry),
 Cases (Smoking tobacco),
 Chairs,
 Crates (Fruit),
 Crates (Truck),
 Cups (Quart),
 Fixtures (Office),
 Fixtures (Store),
 Furniture,
 Hoppers,

Interior trimming,
 Mantels,
 Mine rollers,
 Moldings (Fancy),
 Moldings (Stock),
 Panels,
 Pedestals,
 Pulleys,
 Rockers,
 Stands,
 Tables,
 Tables (Card),
 Tables (Parlor),
 Tables (Sewing),
 Trays.

SOFT MAPLE.

Baskets,
 Crates (Fruit),
 Crates (Truck),
 Furniture,
 Hoppers.

SPANISH OAK.

Blocks (Base),
 Blocks (Corner),
 Boards (Base),
 Brackets (Telegraph pole),
 Cabinets (Kitchen),
 Chairs,
 Cupboards,
 Doors,
 Flooring,
 Furniture,
 Furniture (Mission),
 Implements (Agricultural),
 Interior trimming,
 Moldings (Stock),
 Partition,
 Piano benches,
 Piano stools,
 Rockers,
 Safes (Kitchen),
 Showcases,
 Slack cooperage,
 Sofas,
 Stands,
 Tables (Card),
 Tables (Extension),
 Tables (Kitchen),
 Tables (Library),
 Tables (Parlor),
 Tables (Serving),
 Tables (Typewriter),
 Tight cooperage.

SPRUCE.

Casings,
 Doors,
 Interior trimming,
 Sash,
 Stair work.

SYCAMORE.

Baskets,
Baskets (Grape),
Boxes,
Boxes (Plug tobacco),
Buckets (Candy),
Cabinet work,
Cases (Tobacco),
Fixtures (Office),
Fixtures (Store),
Furniture,
Mantels,
Organs (Pipe),
Organs (Reed),
Shooks (Box).

WHITE CEDAR.

Boat boards,
Casket shells,
Palls,
Shingles,
Ship planking,
Tubs (Wash),
Woodenware.

(WHITE) CYPRESS.

Buckets (Candy),
Palls,
Slack cooperage,
Woodenware.

WHITE PINE.

Blinds,
Boxes,
Boxes (Rough),
Cabinet work,
Casings,
Casket cases,
Cornices,
Doors,
Excelsior,
Exterior trimming,
Fixtures (Office),
Fixtures (Store),
Furniture,
Implements (Farming),
Interior trimming,
Ironing boards,
Organs (Pipe),
Organs (Reed),
Palls,
Sash,
Shelving,
Store fronts,
Washtubs,
Washboards.

WHITE OAK.

Bedroom suits,
Blocks (Base),
Blocks (Corner),

Blocks (Hub),
Boards (Base),
Bolsters (Wagon),
Brackets (Telephone pole),
Brackets (Telegraph pole),
Buckets (Water),
Buckets (Well),
Buggies,
Cabinet work,
Cabinets (China),
Cabinets (Parlor),
Carriages,
Carts,
Chairs,
Chairs (Reclining),
Chiffoniers,
Cradles,
Cultivators,
Davenportes,
Doors,
Dressers,
Felloes,
Fixtures (Office),
Fixtures (Store),
Flooring,
Furniture (Mission),
Gears,
Hall racks,
Harrows,
Implements (Farming),
Interior trimming,
Lamp stands,
Lounges,
Measures,
Molding (Stock),
Panels,
Partition,
Pedestals,
Piano stools,
Piano benches,
Planters,
Plows,
Poles (Coupling),
Rolls,
Rockers,
Seeders,
Showcases,
Sideboards,
Sofas,
Spokes,
Spring bars,
Sulkies,
Tables (Card),
Tables (Extension),
Tables (Kitchen),
Tables (Library),
Tables (Parlor),
Tables (Serving),
Tables (Typewriting),
Tight cooperage,
Tongues (Wagon),
Veneers,

Wagons,
Wardrobes,
Wheels.

(WHITE) POPLAR.

Bed slats,
Boards (Cutting),
Boards (Wash),
Bowls (Chopping),
Cases (Fruit),
Crates (Truck),
Drawer bottoms,
Excelsior,
Furniture,
Mirror backs,
Packages (Vegetable),
Pails,
Tubs (Wash).

YELLOW POPLAR.

Baskets (Fruit),
Balusters,
Bed slats,
Blinds,
Boards (Cutting),
Boards (Wash),
Bowls (Chopping),
Boxes,
Boxes (Rough),
Boxes (Tobacco),
Brackets,
Buckets,
Buggy bodies,
Cabinet work,
Cabinets (Kitchen),
Carriage bodies,
Cases (Fruit),
Cases (Smoking tobacco),
Cases (Vegetable),
Cases (Casket),
Casing,
Caskets,
Ceiling,
Chairs,
Coffins,
Commodies,

Cornices,
Cupboards (Kitchen),
Cups (Berry),
Drawer bottoms,
Excelsior,
Fixtures (Office),
Fixtures (Store),
Furniture,
Hand rails,
Lamp stands,
Mantels,
Mirror racks,
Molding (Stock),
Newel posts,
Organs (Pipe),
Organs (Reed),
Pails,
Piano stools,
Porch columns,
Rockers,
Safes (Kitchen),
Sash,
Showcases,
Siding,
Slack cooperage,
Spindles,
Spools,
Stands,
Store fronts,
Tables,
Tables (Kitchen),
Tables (Library),
Tables (Parlor),
Tables (Sewing),
Veneers,
Wagon beds,
Wagon panels,
Wagon seats,
Wagon tops,
Wainscoting.

ALL OTHERS.

Cabinet work,
Interior trimming,
Mantels,
Panel work.

APPENDIX II.

WOOD MANUFACTURERS OF NORTH CAROLINA.

Concerns giving detailed information of their particular line of manufacture, from which the tables given in this report were compiled, are shown in the following list of names and addresses. Those manufacturing several products classified under different industries will appear in the list of firms named under more than one industry. This was explained previously in discussion of Table 5.

BOXES AND CRATES.

Butters Lumber Co.....	Boardman.
Interstate Cooperage Co.....	Belhaven.
Harrison Wagon Co.....	Cary.
Hill & Daniel.....	Denton.
Carolina Veneer Co.....	Elizabeth City.
National Box Co.....	Elizabeth City.
Fayetteville Woodenware Co.....	Fayetteville.
West Lumber Co.....	Fayetteville.
Dudley Lumber Co.....	Granite Falls.
Oettinger Buggy Co.....	Greensboro.
The Pitt Lumber and Mfg. Co.....	Greenville.
Greenville Lumber and Veneer Co.....	Greenville.
Warlick Lumber Co.....	Gilkey.
R. H. Southerland.....	Henderson.
Corbitt Buggy Co.....	Henderson.
Henderson Mfg. Co.....	Henderson.
Hutton & Bourbonnais.....	Hickory.
High Point Buggy Co.....	High Point.
Tomlinson Chair Mfg. Co.....	High Point.
J. M. Bernhardt.....	Lenoir.
Cahill Chair and Lumber Co.....	Madison.
Magnolia Mfg. Co.....	Magnolia.
White Furniture Co.....	Mebane.
Kincaid Bros. Lumber Co.....	Mocksville.
Morganton Mfg. Co.....	Morganton.
Mount Airy Mantel and Table Co.....	Mount Airy.
G. S. Waters & Son.....	New Bern.
Wilson Lumber and Milling Co.....	North Wilkesboro.
E. E. Wollott.....	Odell.
Plymouth Lumber Co.....	Plymouth.
W. M. Carroll.....	Raleigh.
J. A. Love & Co.....	Red Springs.
J. H. Walker & Co.....	Reidsville.
J. A. Ritchie.....	Ritchfield.
Parker Lumber Co.....	Roaring River.
Sanford Mfg. Co.....	Sanford.
Selma Lumber Co.....	Selma.
S. F. Stevens.....	Spring Hope.
Imperial Furniture Co.....	Statesville.
Bell-Cantwell Lumber Co.....	Wilmington.
Lingo Box Co., Inc.....	Wilmington.
Wynnewood Lumber Co.....	Wilmington.
W. L. Russell Shook and Lumber Co.....	Wilson.
B. F. Huntley Furniture Co.....	Winston-Salem.
J. E. Shelton Box Co.....	Winston-Salem.

CHAIRS.

Ashboro Chair Co.....	Ashboro.
Randolph Chair Co.....	Ashboro.
Newberry Bros. & Cowell.....	Dunn.
George Balley.....	Elkin.
Overman Chair Works.....	Gibsonville.
Best Chair Co.....	High Point.
Southern Chair Co.....	High Point.
Brush Creek Bending Co.....	Jordan.
Lenoir Furniture Co.....	Lenoir.
Moore Furniture Co.....	Lenoir.
Liberty Chair Co.....	Liberty.
Cahill Chair and Lumber Co.....	Madison.
Continental Chair Mfg. Co.....	Mebane.
Harris Chair Co.....	Mellboro.
Mocksville Chair Co.....	Mocksville.
Alexander Chair Co.....	Taylorsville.
Bard Lumber and Mfg. Co.....	Thomasville.
Cates Chair Co.....	Thomasville.
Cramer Furniture Co.....	Thomasville.
Queen City Co.....	Thomasville.
Standard Chair Co.....	Thomasville.
Thomasville Chair Co.....	Thomasville.
Dixie Chair Co.....	Trinity.
Parsons Chair Co.....	Trinity.
Wadesboro Furniture Co.....	Wadesboro.
Walkertown Chair Co.....	Walkertown.
Forsyth Chair Co.....	Winston-Salem.

COFFINS, CASKETS, AND CASKET CASES.

Charlotte Casket Co.....	Charlotte.
Woodland Mfg. Co.....	George.
Rankin Coffin and Casket Co.....	High Point.
Kelford Mfg. Co.....	Kelford.
Rockwell Furniture Co.....	Rockwell.
Hearne Bros. & Co.....	Whitakers.
Turner-White Coffin Co.....	Wilkesboro.

CROSS-ARMS.

J. C. Bruton & Co.....	Fayetteville.
The W. & N. Absher Co.....	North Wilkesboro.
Roaring River Mfg. Co.....	Roaring River.

EXCELSIOR.

High Point Excelsior Co.....	High Point.
Lexington Excelsior Co.....	Lexington.
Salem Excelsior Co.....	Winston-Salem.

FARMING IMPLEMENTS.

Ashboro Wheelbarrow Mfg. Co.....	Ashboro.
Globe Plow Co.....	Greensboro.
Wayne Agriculture Works.....	Goldsboro.
Raleigh Iron Works Co.....	Raleigh.
A. G. Cox Mfg. Co.....	Winterville.

FLOORING, CEILING, SIDING, ETC.

Aberdeen Sash and Blind Co.....	Aberdeen.
Woodland Mfg. Co.....	Albemarle.
Alma Lumber Co.....	Alma.
W. M. Jones.....	Asheville.

Belhaven Lumber Co.....	Belhaven.
Reddick & Windley.....	Belhaven.
Bridger Co.....	Bladenboro.
Butters Lumber Co.....	Boardman.
Waccamaw Lumber Co.....	Bolton.
East River Lumber Co.....	Burgaw.
Burlington Lumber Co.....	Burlington.
J. L. Leary.....	Casar.
Bynum Lumber Co.....	Cameron.
Currie & McQueen.....	Carthage.
Williamson & Brown Land and Lumber Co.....	Cerro-Gordo.
Chadbourn Mfg. Co.....	Chadbourn.
Brown Lumber Co.....	Chadbourn.
Carolina Mfg. Co.....	Charlotte.
Styer's Sash and Door Shops.....	Cherryville.
Clarkton Planing Mill Co.....	Clarkton.
J. C. Taylor.....	Como.
Hill & Daniel.....	Denton.
Snider's Lumber Co.....	Denton.
J. R. Smith Co.....	Dixon.
Goldsboro Lumber Co.....	Dover.
Huffman & Mull.....	Drexel.
Southern Lumber Co.....	Dunn.
Dupree Massengill Lumber Co.....	Dunn.
Durham Lumber Co.....	Durham.
Branning Mfg. Co.....	Edenton.
Rock Ford Mfg. Co.....	Elm City.
Foreman-Blades Lumber Co.....	Elizabeth City.
Kramer Bros. & Co.....	Elizabeth City.
Parker & Thorn.....	Enfield.
H. Freeman & Son.....	Ether.
Fayetteville Planing Mill Co.....	Fayetteville.
Ashboro Lumber and Mfg. Co.....	Fayetteville.
Cumberland Lumber Co.....	Fayetteville.
McDermid Lumber Co.....	Fayetteville.
Regal Mfg. Co.....	Forest City.
Dove Lumber Co.....	Floral Springs.
Page Co.....	Gastonia.
Woodland Mfg. Co.....	George.
J. W. Jessup.....	George.
Warlick Lumber Co.....	Gilkey.
Pitts & Gilles.....	Glen Alpine.
J. D. Pitts.....	Glen Alpine.
Broadway Lumber Co.....	Glaresville.
Enterprise Lumber Co.....	Goldsboro.
Walker & McAdams.....	Graham.
Thaw-Clapp Lumber Co.....	Greensboro.
Cape Fear Mfg. Co.....	Greensboro.
Gulford Lumber Mfg. Co.....	Greensboro.
South Atlantic Lumber Co.....	Greensboro.
E. E. Bain & Son.....	Greensboro.
Brooks Mfg. Co.....	Greensboro.
Pitts & Monroe.....	Greensboro.
Pitts Lumber and Mfg. Co.....	Greenville.
Bennett Bros.....	Hendersonville.
Albemarle Lumber Co.....	Hertford.
Hutton & Bourbonnais.....	Hickory.
Hickory Mfg. Co.....	Hickory.
Snow Lumber Co.....	High Point.
Suffolk Lumber Co.....	Jacksonville.
Jacksonville Lumber Co.....	Jacksonville.
Moore Lumber Co.....	Jonesboro.

D. B. Sasser.....	Kenly.
Kernersville Mfg. Co.....	Kernersville.
Lattimore Lumber Co.....	Kingsdale.
Kingsdale Lumber Co.....	Kingsdale.
Lenoir Woodworking Co.....	Lenoir.
Eagle Lumber Co.....	Lexington.
Little River Lumber Co.....	Linden.
Magnolia Mfg. Co.....	Magnolia.
L. T. Cottingham.....	Maxton.
United Lumber Co.....	Maxton.
Nelson Cooper Lumber and Furniture Co.....	Mebane.
H. A. Rankin.....	Mints.
Kincaid Bros. Lumber Co.....	Mocksville.
Ray Lumber Co.....	Moltonville.
Monroe Mfg. Co.....	Monroe.
Mooreville Furniture Lumber Co.....	Mooreville.
Snow Lumber Co.....	Mount Gilead.
Munger & Bennett.....	New Bern.
Pine Lumber Co.....	New Bern.
Broaddus & Ives Lumber Co.....	New Bern.
Neuse Lumber Co.....	New Bern.
Gaither Mfg. Co.....	Newton.
Laus Lumber Co.....	Norlina.
Davis-Keith & Connelly.....	Northside.
Wilkesboro Mfg. Co.....	North Wilkesboro.
E. E. Wollott & Co.....	Odell.
Cohaire Lumber Co.....	Parkesburg.
Parsons Lumber Co.....	Parsons.
Brown-Shaw Lumber Co.....	Pembroke.
Pembroke Planing Mill Co.....	Pembroke.
Builders Lumber Co.....	Raeford.
Baker-Thompson Lumber Co.....	Raleigh.
R. D. Thompson.....	Richlands.
J. A. Ritchie.....	Richfield.
Messick Crate Factory.....	Rocky Point.
Carr Lumber Co.....	Rose Hill.
Rowland Mfg. Co.....	Rowland.
Long, Spencer & Co.....	Roxboro.
Oakwood Mfg. Co.....	Rutherfordton.
Carpenter-Taylor Co.....	Rutherfordton.
Graf-Davis-Collet Lumber Co.....	Salisbury.
C. M. Thompson.....	Salisbury.
C. H. Smith.....	Sanford.
Selma Lumber Co.....	Selma.
Shelby Woodworking Co.....	Shelby.
Montgomery Lumber Co.....	Spring Hope.
J. H. Saunders.....	Spring Hope.
Z. T. Wright & Sons.....	Star.
Sylva Lumber and Mfg. Co.....	Sylva.
Southern and Norfolk Junction Planing Mill Co.....	Thomasville.
Gulford Lumber Mfg. Co.....	Troy.
A. Cameron.....	Vass.
Frank Buele.....	Wallace.
Leight Bros.....	Walkertown.
Moss Planing Mill Co.....	Washington.
W. B. Walling.....	Washington.
House Mfg. Co.....	Weldon.
Whiteville Lumber Co.....	Whiteville.
Chadbourn Sash, Door and Lumber Co.....	Wilmington.
Hilton Lumber Co.....	Wilmington.
Bell-Cantwell Lumber Co.....	Wilmington.
Wynnewood Lumber Co.....	Wilmington.

C. M. & W. G. Wilson.....	Wilson's Mills.
W. W. Sims Co.....	Wilson.
Fogle Bros. & Co.....	Winston-Salem.
J. H. Phillips.....	Winston-Salem.
Miller Bros.....	Winston-Salem.

FRUIT AND VEGETABLE PACKAGES.

Brown Lumber Co.....	Chadbourn.
Wilkes Veneer Co.....	Edenton.
Carolina Basket and Veneer Co.....	Elizabeth City.
Fayetteville Lumber and Crate Mfg. Co.....	Fayetteville.
Cabinet Veneer Co.....	Greenville.
Greenville Lumber and Veneer Co.....	Greenville.
Utility Mfg. Co.....	Goldsboro.
Magnolia Mfg. Co.....	Magnolia.
John T. Croom & Bro.....	Magnolia.
Union Point Lumber Co.....	New Bern.
James Love & Co.....	Red Springs.
The Dixie Co.....	Rose Hill.
Messick Crate Factory.....	Rocky Point.
Eureka Lumber Co.....	Washington.
Lingo Box Co.....	Wilmington.

FURNITURE.

Albemarle Furniture and Mfg. Co.....	Albemarle.
Yorke Furniture Co.....	Concord.
Cornelius Furniture Co.....	Cornelius.
Styer's Sash and Door Shops.....	Cherryville.
Hill & Daniel.....	Denton.
Drexel Furniture Co.....	Drexel.
The Branning Mfg. Co.....	Edenton.
Wilkes Veneer Co.....	Edenton.
Elkin Furniture Co.....	Elkin.
Elkin Veneer and Mfg. Co.....	Elkin.
W. S. Rich Furniture Mfg. Co.....	Elkin.
H. Freeman & Sons.....	Ether.
Goldsboro Furniture Mfg. Co.....	Goldsboro.
Gate City Furniture Co.....	Greensboro.
Greensboro Furniture Mfg. Co.....	Greensboro.
Martin Furniture Co.....	Hickory.
Hickory Furniture Co.....	Hickory.
Marsh Furniture Co.....	High Point.
Hayworth Roll and Panel Co.....	High Point.
Globe-Home Furniture Co.....	High Point.
Atlantic Furniture Co.....	High Point.
Kearns Furniture Co.....	High Point.
Union Furniture Co.....	High Point.
Welch Furniture Co.....	High Point.
The Continental Furniture Co.....	High Point.
Myrtle Desk Co.....	High Point.
High Point Furniture Co.....	High Point.
Columbia Furniture Co.....	High Point.
Eagle Furniture Co.....	High Point.
Southern Novelty Co.....	High Point.
Lenoir Woodworking Co.....	Lenoir.
Harper Furniture Co.....	Lenoir.
Moore Furniture Co.....	Lenoir.
Kent-Coffey Mfg. Co.....	Lenoir.
Kent Furniture Co.....	Lenoir.
Tate Mfg. Co.....	Lenoir.
American Furniture Co.....	Lexington.

Elk Furniture Co.....	Lexington.
Lexington Upholstering Co.....	Lexington.
Dixie Furniture Co.....	Lexington.
Catawba Furniture Co.....	Marion.
McDowell Furniture Co.....	Marion.
Blue Ridge Furniture Co.....	Marion.
The White Furniture Co.....	Mebane.
Alton Mfg. Co.....	Mebane.
Mocksville Furniture Co.....	Mocksville.
Mooreville Furniture Co.....	Mooreville.
Morganton Furniture Co.....	Morganton.
Banner Mfg. Co.....	Mount Airy.
Mount Airy Furniture Co.....	Mount Airy.
National Furniture Co.....	Mount Airy.
Mount Airy Mantel and Table Co.....	Mount Airy.
Murphy Furniture Mfg. Co.....	Murphy.
Oak Furniture Co.....	North Wilkesboro.
Forest Furniture Co.....	North Wilkesboro.
Oxford Furniture Co.....	Oxford.
K. Nicholson.....	Pilot Mountain.
Ramseur Furniture Co.....	Ramseur.
Skyland Furniture Shop.....	Skyland.
T. O. Spencer.....	Sopha.
North State Veneer Co.....	Statesville.
Imperial Furniture Mfg. Co.....	Statesville.
Kincaid Furniture Co.....	Statesville.
Statesville Furniture Co.....	Statesville.
Statesville Safe and Table Co.....	Statesville.
Lambert Furniture Co.....	Thomasville.
Thomasville Furniture Co.....	Thomasville.
Wallburg Lounge Co.....	Wallburg.
Waynesville Furniture Co.....	Waynesville.
Oakland Mfg. Co.....	Winston-Salem.
B. F. Huntley Furniture Co.....	Winston-Salem.
Forsyth Furniture Co.....	Winston-Salem.
Winston Furniture Co.....	Winston-Salem.
J. E. Shelton Box Co.....	Winston-Salem.
A. G. Cox Mfg. Co.....	Winterville.

INSULATOR PINS AND BRACKETS.

The Blue Ridge Locust Pin Co.....	Dillsboro.
J. C. Bruton.....	Fayetteville.
Clarence Call.....	North Wilkesboro.

KITCHEN SAFES, CABINETS, AND CUPBOARDS.

Alma Furniture Co.....	High Point.
Kitchen Cabinet and Table Co.....	High Point.
Marsh Furniture Co.....	High Point.
Caldwell Furniture Co.....	Lenoir.
Fitts-Crabtree Mfg. Co.....	Sanford.

PIPES, PULLEYS, AND MINE ROLLERS.

Southern Roller, Stave and Heading Co.....	Elizabeth City.
Boon & Thine.....	Fayetteville.
Putnam Pipe Co.....	Phenoy.
Eureka Lumber Co.....	Washington.

PLANKING FOR BOATS.

Ezzell Bros. & Co.....	Sessoms.
Cain & Willis.....	Tarheel.
H. A. Bozart.....	Wade.

SASH, DOORS, BLINDS, ETC.

Aberdeen Sash and Blind Co.....	Aberdeen.
Woodland Mfg. Co.....	Albemarle.
Azalea Woodworking Co.....	Asheville.
Wm. M. Jones.....	Asheville.
J. R. Smith Co. & Dixon.....	Ayden.
Reddick & Windley.....	Belhaven.
G. W. Anthony.....	Burlington.
Burlington Lumber Co.....	Burlington.
Bryson City Pump Co.....	Bryson City.
J. L. Leary.....	Casar.
Carolina Mfg. Co.....	Charlotte.
W. J. M. Finger.....	Charlotte.
Styer's Sash and Door Shops.....	Cherryville.
Flay Lumber Co.....	Cherryville.
Sells Lumber Co.....	Concord.
Snider's Lumber Co.....	Denton.
Huffman & Mull.....	Drexel.
Southern Lumber Co.....	Dunn.
Durham Lumber Co.....	Durham.
Branning Mfg. Co.....	Edenton.
Parker & Thorn.....	Enfield.
Fayetteville Planing Mill Co.....	Fayetteville.
Regal Mfg. Co.....	Forest City.
Bush Creek Mfg. Co.....	Franklinville.
The Page Co.....	Gastonia.
Woodland Mfg. Co.....	George.
Walker & McAdams.....	Graham.
Dudley Lumber Co.....	Granite Falls.
Cape Fear Mfg. Co.....	Greensboro.
Guilford Lumber Co.....	Greensboro.
Shaw-Clapp Lumber Co.....	Greensboro.
The Pitt Lumber and Mfg. Co.....	Greenville.
Hickory Novelty Co.....	Hickory.
Hickory Mfg. Co.....	Hickory.
Snow Lumber Co.....	High Point.
Jonesboro Sash and Blind Co.....	Jonesboro.
Lenoir Woodworking Co.....	Lenoir.
Maxton Sash and Door Co.....	Maxton.
Nelson-Cooper Lumber and Furniture Co.....	Mebane.
Kincaid Bros. Lumber Co.....	Mocksville.
Monroe Mfg. Co.....	Monroe.
Mooreville Furniture Co.....	Mooreville.
Morganton Mfg. and Trading Co.....	Morganton.
J. A. Tesh.....	Mount Airy.
The Woodworking Co.....	New Bern.
Gaither Mfg. Co.....	Newton.
Laus Lumber Co.....	Norlina.
Wilkesboro Mfg. Co.....	North Wilkesboro.
Builders Lumber Co.....	Raeform.
Baker-Thompson Lumber Co.....	Raleigh.
Ellington Building Supply Co.....	Raleigh.
Ellington Lumber Co.....	Raleigh.
Carpenter, Taylor & Co.....	Rutherfordton.
Oakwood Mfg. Co.....	Rutherfordton.
C. M. Thompson Furniture and Woodworking Co.....	Salisbury.
Graf-Davis-Collett Lumber Co.....	Salisbury.
Sanford Sash and Blind Co.....	Sanford.
Shelby Woodworking Co.....	Shelby.
The Thompson-Branton Co.....	Shelby.
Overcash Bros.....	Statesville.
Sylva Lumber and Mfg. Co.....	Sylva.

Southern and Norfolk Junction Planing Mill Co.....	Thomasville.
Leight Bros.....	Walkertown.
Moss Planing Mill Co.....	Washington.
H. L. Moody.....	Waynesville.
House Mfg. Co.....	Weldon.
R. A. Spainhaur.....	Wilkesboro.
W. W. Sims.....	Wilson.
C. M. & W. G. Wilson Lumber Co.....	Wilson's Mills.
Chadbourn Sash, Door and Lumber Co.....	Wilmington.
Fogle Bros. Co.....	Winston-Salem.
Miller Bros.....	Winston-Salem.
J. H. Phillips.....	Winston-Salem.

SHUTTLES, SPOOLS, BOBBINS, ETC.

Southern Bobbin, Shuttle and Spool Co.....	Greensboro.
Warlick & Whisnant.....	Granite Falls.
J. Elwood Cox Mfg. Co.....	High Point.
Linwood Mfg. Co.....	Linwood.
Novelty Woodworks.....	Ramseur.
The Torrence Co.....	Waynesville.
Winston Handle Co.....	Winston-Salem.

STORE AND OFFICE FIXTURES, ETC., AND MUSICAL INSTRUMENTS.

Wm. M. Jones.....	Asheville.
Azalea Woodworking Co.....	Asheville.
C. J. Smith & Son.....	Ayden.
Burlington Lumber Co.....	Burlington.
Cochrane Showcase Co.....	Charlotte.
J. H. Wearn & Co.....	Charlotte.
Durham Lumber Co.....	Durham.
Guilford Lumber and Mfg. Co.....	Greensboro.
The Pitt Lumber and Mfg. Co.....	Greenville.
High Point Molding Co.....	High Point.
High Point Showcase Works.....	High Point.
Shipman Organ Co.....	High Point.
Lenoir Woodworking Co.....	Lenoir.
Monroe Manufacturing Co.....	Monroe.
Mooreville Furniture Co.....	Mooreville.
Will Carroll.....	Raleigh.
Carolina Woodworkers Co.....	Raleigh.
Fogle Bros. & Co.....	Winston-Salem.

TABLES, STANDS, AND EXTENSION TABLES.

Warlick & Whisnant Co.....	Granite Falls.
Standard Table Co.....	Greensboro.
The Pitt Lumber and Mfg. Co.....	Greenville.
Alma Furniture Co.....	Monroe.
Dalton Furniture Co.....	High Point.
A. F. Ellison.....	High Point.
Garland Lumber Co.....	High Point.
Kitchen Cabinet and Table Co.....	High Point.
Marsh Furniture Co.....	High Point.
Blue Ridge Bending Co.....	Lenoir.
Mount Airy Mantel and Table Co.....	Mount Airy.
Fitts-Crabtree Mfg. Co.....	Sanford.
Sanford Mfg. Co.....	Sanford.
Statesville Safe and Table Co.....	Statesville.
Lee Mfg. Co.....	Thomasville.
Parsons Chair Co.....	Trinity.
W. Wood Mfg. Co.....	Waynesville.

TOOL AND MACHINERY HANDLES.

Ashboro Wheelbarrow and Mfg. Co.....	Ashboro.
French Broad Mfg. Co.....	Barnard.
J. D. Pitts.....	Glen Alpine.
A. W. Vickery & Co.....	Greensboro.
J. Elwood Cox Mfg. Co.....	High Point.
Morganton Spoke and Handle Co.....	Morganton.
Smith-Kiser Mfg. Co.....	Rural Hall.
Thomasville Spoke Works.....	Thomasville.
The Torrence Co.....	Waynesville.
Winston Handle Co.....	Winston-Salem.

VEHICLES.

Ashboro Wheelbarrow and Mfg. Co.....	Ashboro.
C. J. Smith & Son.....	Ayden.
The Tyson & Jones Buggy Co.....	Carthage.
Harrison Wagon Co.....	Cary.
Z. V. Johnson & Co.....	Cary.
J. W. Jessups.....	George.
J. D. Pitts.....	Glen Alpine.
Oettinger Buggy Co.....	Greensboro.
The John Flanagan Buggy Co.....	Greenville.
Corbitt Buggy Co.....	Henderson.
Henderson Mfg. Co.....	Henderson.
Piedmont Wagon Co.....	Hickory.
Beeson Mfg. Co.....	High Point.
North Carolina Wheel Co.....	High Point.
High Point Buggy Co.....	High Point.
George T. Parker.....	Kelford.
Blue Ridge Bending Co.....	Lenoir.
Piedmont Buggy Co.....	Monroe.
Mount Airy Buggy Co.....	Mount Airy.
S. E. Marshall & Co.....	Mount Airy.
G. S. Waters & Son.....	New Bern.
Harris-Glenn Body Co.....	Oxford.
Southern Wheel Co.....	Oxford.
Taylor-Cannady Buggy Co.....	Oxford.
Sanford Buggy Co.....	Sanford.
Thomasville Spoke Works.....	Thomasville.
Washington Buggy Co.....	Washington.
James H. Brown & Co.....	Wilmington.
Hackney Wagon Co.....	Wilson.
C. F. Nissen.....	Winston-Salem.
George E. Nissen.....	Winston-Salem.
S. J. Nisson.....	Winston-Salem.
Spack Bros.....	Winston-Salem.
Winston Vehicle Co.....	Winston-Salem.

WOODENWARE.

The Guernsey Mfg. Co.....	Bee Log.
Fayetteville Woodenware Co.....	Fayetteville.
Morganton Spoke and Handle Co.....	Morganton.

PUBLICATIONS
OF THE
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes, and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*
11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 6 cents.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade Trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°. 38 pp., 6 pl., 2 figs. *Postage 4 cents.*

18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents.*

19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*

20. Water-powers of North Carolina: An Appendix to Bulletin 8. *In Press.*

21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*

22. A Report on the Cld Mining District, by J. E. Pogue, Jr. *In Press.*

ECONOMIC PAPERS.

1. The Maple-Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a List of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virginina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestone; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos, and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial

Varieties of Mica, giving the manner in which it occurs in North Carolina. Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorlanite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including Classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.

15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

19. Forest Fires in North Carolina During 1909, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pls. *Postage 3 cents.*

20. Wood-using Industries of North Carolina, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Postage 5 cents.*

VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. The Physiography and Geography of the Coastal Plain Region of North Carolina. *In Press.*

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of *postage* needed, as indicated above, for mailing the bulletins desired, to the *State Geologist, Chapel Hill, N. C.*

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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

ECONOMIC PAPER No. 21

PROCEEDINGS
OF
THIRD ANNUAL DRAINAGE CONVENTION
HELD AT
WILMINGTON, NORTH CAROLINA

NOVEMBER 22 AND 23, 1910

AND

NORTH CAROLINA DRAINAGE LAW

(CODIFIED)

COMPILED BY
JOSEPH HYDE PRATT



RALEIGH
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LETTER OF TRANSMITTAL

CHAPEL HILL, N. C., April 5, 1911.

To His Excellency, HON. W. W. KITCHIN,

Governor of North Carolina.

SIR:—The Third Annual Drainage Convention held under the auspices of the North Carolina Drainage Association convened at Wilmington, N. C., on November 22, 1910. The work accomplished by this Convention and by its legislative committee is of such State-wide importance that I recommend that the proceedings of the Convention and the codified drainage law be published as Economic Paper No. 21 of the publications of the North Carolina Geological and Economic Survey.

Yours respectfully,

JOSEPH HYDE PRATT,
State Geologist.

CONTENTS.

	PAGE
Introduction	7
Proceedings of the Convention.....	8
Morning Session, November 22d.....	8
Secretary's Report	9
Appointment of Committees.....	10
Afternoon Session, November 22d.....	11
Night Session, November 22d.....	14
Session, November 23d.....	15
Report of Committee on Resolutions.....	16
Report of Committee on Nominations.....	18
Tile Drainage, by J. R. HASWELL, assistant drainage engineer, U. S. Department of Agriculture.....	21
North Carolina Drainage Law (Codified).....	30
Decision of Supreme Court of North Carolina—Validity of Drainage Bonds.	57

PROCEEDINGS OF THE THIRD ANNUAL DRAINAGE CON-
VENTION HELD UNDER AUSPICES OF THE NORTH
CAROLINA DRAINAGE ASSOCIATION

AND

THE NORTH CAROLINA DRAINAGE LAW
(CODIFIED).

COMPILED BY JOSEPH HYDE PRATT, STATE GEOLOGIST.

INTRODUCTION.

The interest in the drainage of North Carolina swamp and overflowed lands has continued to grow, and now there are but few sections of the coastal plain or Piedmont regions of the State that are not taking a deep interest in the reclamation of our swamp and overflowed areas. The North Carolina Drainage Law that was passed by the General Assembly of 1909 has been operative for nearly two years, and many drainage districts were and are being organized under the authority of this act. Until the passage of this act it had been almost impossible to carry on the drainage of any of the large areas of swamp or overflowed land, for there was no law that made it possible to continue the work when objections were made by any of the property-owners or to obtain outlets for the canals, nor was it possible to provide the revenue to carry on the work. The law of 1909 solved all these difficulties to a certain extent, but it was found after two years that it was necessary to amend the law in order to make it still more operative, and this question was one of the main ones discussed at the Convention.

There still seems to be considerable misunderstanding regarding the practicability of draining our swamp and overflowed lands, and in some localities, even after the reports of the drainage engineer have shown that the proposition of draining a certain area is feasible, men of considerable prominence and ability have spread the report that the proposition was impracticable and meant the loss of land to those entering the district. Even a casual study of the North Carolina Drainage Law will convince any one that it is impossible under the law to undertake the drainage of any district unless it is a feasible and practicable proposition.

The Third Drainage Convention was held under the auspices of the North Carolina Drainage Association, and delegates were invited from

nearly all the counties and towns of eastern and central North Carolina, the delegates being appointed by the Governor, mayors of cities, and county commissioners.

The following counties were represented: Anson, Beaufort, Bladen, Brunswick, Buncombe, Cabarrus, Chowan, Columbus, Craven, Currituck, Duplin, Hyde, New Hanover, Onslow, Orange, Pamlico, Pender, Pitt, Robeson, Sampson, Tyrrell, Union, Wake, Warren, and Wilson.

PROCEEDINGS OF THE CONVENTION.

MORNING SESSION, NOVEMBER 22, 1910.

The first meeting of the Convention was called to order on Tuesday morning, November 22d, at 10:30 o'clock, by Joseph A. Brown, President. Prayer was offered by the Rev. Dr. J. H. Foster, pastor of the First Baptist Church. The President then called upon Hon. Walter G. MacRae, Mayor of Wilmington, who welcomed the delegates and visitors to the city. He said in part:

Mr. President and Gentlemen of the Drainage Convention: Some one has threatened this Convention with a speech from the mayor. Be of good cheer; for you shall realize during your stay that you are welcome without having to listen to an address upon the Cosmogony of the Universe. Taking the most selfish view of the situation, we want you here because the eastern part of the State will be most benefited by your deliberations; but there is no selfishness in the pleasure of receiving you. We wish that every man in the State would come to the city at least once a year; for there is not a nook or corner of North Carolina which we do not love. In this assembly you have men who have studied and who understand the science of drainage, and you have also men with the executive ability to organize any movement which may be determined upon, and to push it to a successful issue. Therefore, the citizens of Wilmington are proud to have you here, and we confidently look for the best results from your work.

The response to the address of welcome was made in behalf of the Association by President Brown. He thanked the mayor for his cordial words, and stated that each and every one of the delegates appreciated to the utmost the warm and friendly greeting. President Brown then referred to the importance of drainage work. He stated that North Carolina just now is entering upon an era of prosperity and advancement which renders imperative the reclamation of all swamp and waste lands in the State as soon as possible, so that they may be used for farming and other agricultural purposes. As an evidence of the value of drainage, President Brown stated that an amount of money was made in the Chadbourn District last year sufficient to defray the cost of draining an entire district. President Brown stated that what had been

accomplished there could be done in other sections of the State. He concluded with an earnest appeal that the people awaken to a realization of the tremendous possibilities which the development of waste and swamp lands has in store for North Carolina.

After thanking the mayor again for his welcome in behalf of the city, President Brown stated that the Association was open for business.

The President then called for the report of the Secretary, Joseph Hyde Pratt.

SECRETARY'S REPORT.

I submit as the Secretary's report of the last meeting of the Convention and of the Association the report of the Convention as published by the North Carolina Geological and Economic Survey in Economic Paper No. 18, and, as we have plenty of these pamphlets for distribution, I do not believe that it is worth the time of the Convention to have that report read here.

The work of the Association during the past year has been very closely identified with that of the North Carolina Geological and Economic Survey, as the State Geologist is Secretary of the Association. No special meetings of the Association have been held during the past year, but the State Geologist has kept in close touch with all of the work that has been done in the State in connection with drainage, in the eastern North Carolina swamp lands and the overflowed lands of Piedmont North Carolina. It is gratifying to be able to report that these three drainage projects have been practically completed; two in eastern North Carolina, in Tolsnot Swamp, Wilson County, and one in Beaufort County, and the other in Piedmont North Carolina on the overflowed lands of Clark's Creek. Five other drainage districts have been organized and final reports made, and in two instances the contracts have been let for the construction of the canals, and in the other three, contracts will be let within a short time. There are now, altogether, twenty-odd drainage districts, either organized or in process of organization, representing something over 500,000 acres. Several press bulletins have been published during the year relating to drainage work in the State, which have been generally distributed throughout North Carolina. It has been the object of the Association and of the Geological Survey to disseminate as widely as possible information regarding drainage work, what it will accomplish, and its value to those sections in which it is inaugurated.

The North Carolina Drainage Law has been published in pamphlet form and also very widely distributed. Requests have been received from Georgia, South Carolina, and Virginia for copies of the proceedings of our Association, and also copies of the North Carolina Drainage Law, from men who are interested in having as satisfactory a law passed for their States as we have in North Carolina. Similar requests for these pamphlets have also been received from many Congressmen, thus showing that many others are watching the work in North Carolina besides those in the State who are directly interested in it.

I believe we can say without boasting that a considerable part of the success of the drainage work in this State has been due to the work of the North Carolina Drainage Association.

The following committees were then appointed by the President:

Committee on Resolutions—Congressman John H. Small, chairman; Messrs. A. B. Croom, Jr., J. S. Mann, W. C. Stinson, and W. S. Privott.

Membership Committee—Joseph Hyde Pratt, chairman; Messrs. B. F. Keith, D. Boughnor, John Wilkinson, and J. T. Foy.

Committee on Nominations and Selecting Next Meeting Place—Congressman John M. Faison, chairman; Messrs. George T. Farrill, A. B. Lukens, Sellers, Layton, and Pratt.

The Secretary then delivered a message from Governor W. W. Kitchin, who had expected to attend the Convention, but was at the last moment detained in Raleigh. He sent his best wishes to the Convention and stated positively that he would be at the next Annual Drainage Convention.

President Brown then called on a number of members present for short talks. The principal points emphasized by each were as follows:

Mr. J. A. Taylor, President of the Chamber of Commerce, stated that he was impressed by the "commercial necessity which demands the reclamation of swamp lands in the State," and cited Chadbourn District as an instance of progressive development following the reclamation of lands which were once regarded as worthless.

Mr. John A. Wilkinson of Belhaven, a former President of the Association, spoke most interestingly of his experience with improved drainage projects now completed in the eastern part of the State. He is a resident of Belhaven, and the territory surrounding that town is the land which has been so wonderfully benefited through extensive canalization of the swamp regions. Mr. Wilkinson stated that the residents had made sufficient from their improved lands to defray the cost of drainage. "Why the people neglect the important matter of drainage is incomprehensible when the wonderful results obtained from the improved lands are considered," observed Mr. Wilkinson.

As an instance of what is being done, he said that 640 acres of virgin forest land had been reclaimed last year by the owners; this season, from the proper cultivation and drainage, the tract had yielded from 10 to 20 barrels of corn per acre. He stated that in his section three canals had been dug, varying in width from 20 to 35 feet and in depth from 6 to 8 feet. One of these canals is 11 miles long, and the amount of land drained by each of the three canals varies from 8,000 to 14,000 acres. The land in this territory is about 20 feet above sea-level and the approximate cost of dredging the canals was about 8 cents a cubic yard. The Albemarle Swamp, which is drained by the three canals, is

nearly as large as the Dismal Swamp, and vast quantities of splendid land have been opened to cultivation. Not only have farms been improved through the installation of the canals, but fine roads have been built along their banks. Mr. Wilkinson stated that these reclaimed lands are being sold at \$20 per acre, and that hundreds of persons are eagerly accepting the opportunity to secure tracts which almost yield crops without cultivation, so rich and fertile is the land. The effect of drainage upon the health of the community has been very salutary. The cost of digging the canals was shared equally by those in the drainage districts and the assessments were made on a pro rata basis, according to size of farms and values received from drainage. The bonds were issued for a thirteen-year period. During the first three years only interest charges are paid, but during the final ten-year period the principal is returned at the rate of 1-10 of the entire sum each year. In this manner the farmers are benefited from the beginning by proper drainage, and they scarcely feel the payments for the improvements.

Mr. William C. Stinson of New York City, who is interested in the Moyock Drainage District, made a very interesting talk on "The Swamp Lands of North Carolina as Profitable Investments."

The next speaker was Mr. Haswell, a representative of the U. S. Department of Agriculture, who made a most interesting talk on "Tile Drainage." This paper is printed at the end of the proceedings, on p. 21.

Following Mr. Haswell, Senator Brown introduced Senator Simmons, who, in a general way, spoke of the benefits to be derived from proper drainage, both as to the increased values of property and the very marked connection between good drainage and health and material prosperity.

AFTERNOON SESSION, TUESDAY, NOVEMBER 22, 1910.

The afternoon session convened at 3 o'clock, with President Brown presiding. "Drainage Problems and Drainage Bonds" was the subject of an interesting address by Joseph Hyde Pratt, State Geologist. After referring to the enormous problems which must be surmounted in land drainage, Mr. Pratt turned to the question of drainage bonds.

Following the talk of Mr. Pratt, the President introduced Mr. Lawrence Brett of the Brett Engineering Contract Company, of Wilson, N. C., who spoke briefly on the "Practical Work Under the North Carolina Drainage Law." Mr. Brett said that what was needed now was the education of the people to the advantages to be derived from draining their lands. He suggested certain minor changes in the law, and

also suggested the appointment of a committee to draft the desired amendments to be submitted to the next Legislature.

Five-minute talks were then called for from representatives of the various drainage districts.

Mr. B. F. Keith of Wilmington spoke for Lyon Swamp District. He suggested an amendment whereby drainage districts may be formed in less time than is now required.

Mr. A. B. Lukens of Moyock, Currituck County, a member of the commission in the first drainage district organized under the new law, spoke for the Moyock Drainage District. He said that a canal 30 feet wide and 8 feet deep was begun some weeks prior to this Convention, and is progressing satisfactorily.

Dr. William C. Stinson of New York City said that it was proposed to make Dismal Swamp blossom like the rose by draining it.

Mr. Julian S. Mann of the board of commissioners in charge of the drainage of Mattamuskeet Lake, Hyde County, spoke very interestingly regarding that work.

Mr. F. F. Wetmore of Lumberton told of what has been done in Robeson County, where a drainage district has recently been formed. Mr. Wetmore thought there should be some change in the law requiring summons in person of all landowners not signing petition of the district. He said that in his county it was impossible to find all the landowners, owing to the fact that some of the land is in controversy. He suggested an amendment to the law, permitting service of summons by publication where the parties cannot be found.

Several of the speakers referred to lack of funds to make surveys of drainage districts. They suggested that the State should provide the Geological Survey Department with funds sufficient for the employment of an engineer to make surveys, and when the bonds are sold by the drainage districts pay back the amount expended for surveys, this money to be used in similar work elsewhere under the direction of the State Geologist.

The Secretary then read a telegram from Congressman Godwin, as follows:

I find at last minute pressing official duties looking to the convening of Congress will prevent me from attending the Drainage Convention. I regret this, as I am heart and soul with you in the great effort to drain the swamp lands of our State. If present, I don't know that I could add to what will be said in behalf of drainage by the able speakers who have made a careful study of this question; but later on I will send you a letter giving my views of how to secure the early reclamation of our swamp lands.

(Signed) H. L. GODWIN.

A letter was then read from Mr. J. O. Wright, General Drainage Engineer of the Trustees of the Internal Improvement Fund of the State of Florida, Tallahassee, Florida, under date of November 19, 1910, as follows:

Please convey to the Drainage Convention my most cordial greeting and best wishes. I had hoped to be present at this, the third annual meeting of the Association, but the Drainage Commission of Florida has decided to visit the Everglades the coming week and desire me to accompany them.

Although I have charge of large and important work here, I still have a deep interest in the drainage work of North Carolina; so much so that I contemplate establishing my legal residence in the good Old North State in the near future and spending the rest of my days in promoting the drainage and development of her rich agricultural lands.

If you desire to keep up with the procession, in the language of our worthy President, Mr. Brown, "You must keep walking." The State of Florida has established a drainage district embracing four and one-half million acres, and has let a contract for excavating upwards of 20,000,000 cubic yards of earth and stone. This work is now well under way; we have six dredges in operation and are removing almost 500,000 cubic yards per month.

The commencement of this work has had a wonderful effect on the price of the lands in the drainage district. Three years ago, the State sold a large amount of these lands in alternate sections at \$2 per acre; during the past week it has closed a contract for 50,000 acres of the remaining sections of the lands previously sold, at \$15 per acre. This is not a speculative deal, but an actual cash sale which shows an advance of 650 per cent in three years. This land is being resold by the purchasers in small tracts at a still higher price. No better illustration of the profitableness of reclaiming swamp lands by drainage can be found.

The lands in Eastern North Carolina are just as good as the lands in the Everglades; are well suited for growing staple crops and are within a short distance of the great markets of the country, and when drained and sufficiently advertised to attract public attention will, in my judgment, show even greater results.

With kind regards, I am, etc.,

Mr. C. G. Elliott, Chief of Drainage Investigations, United States Department of Agriculture, Washington, D. C., under date of November 17, 1910, wrote as follows:

In response to your invitation that some one from this office discuss the subject of tile drainage at the convention to be held at Wilmington November 22, I take pleasure in saying that Mr. J. R. Haswell, Assistant Drainage Engineer of this office, will be present and present a paper upon the improvement of farm lands by tile drainage. Mr. Haswell has become acquainted with some of the North Carolina lands in the design of drainage works for some of the test farms being conducted by the State Board of Agriculture. He has also had experience in such work in Kentucky, Virginia, and New York.

I have never been privileged to attend one of the State drainage conven-

tions, but you may rest assured of my interest in the work of bettering the fertile lands of the State by approved and systematic drainage, and I wish you and those who are promoting such work a most profitable session.

Yours sincerely,

President Brown then introduced Congressman John H. Small, whom he referred to as a noted worker for waterways and drainage. Congressman Small made a splendid address which reflected his deep enthusiasm for drainage and waterway propositions. He discussed the value of proper drainage in relation to successful agriculture and stated that it has been recognized for more than one hundred years that lands must be properly drained to yield the best crops. Gratification was expressed by the speaker at the inauguration of the drainage movement by the United States Department of Agriculture. He says that not only do swamp lands need draining, but more lands, 6,000,000 acres of which are under cultivation, need better attention. Mr. Small entered a plea for a campaign of education among the people in the country sections, believing that it is only through education that ultimate results can be obtained.

A telegram was then read from Messrs. C. T. Bennett and C. E. Foy of New Bern, Craven County, N. C., as follows:

"We are anxious to have the next Drainage Convention held at New Bern, and beg to ask your good influence to bring it here, with your headquarters at the Gaston House."

A telegram was also received from Mr. E. F. Lamb, President of the Chamber of Commerce of Elizabeth City, inviting the Association to hold its 1911 Convention in that city.

Mr. C. R. Vandecarr of New York, who is interested in swamp lands of Currituck County, sent the following telegram to the Convention:

"Remember me gladly to all. Impress upon the Convention that the country is looking at the progress of North Carolina and talking about her progressiveness. Keep up the drainage work in the Old North State so that other States may have a good leader. I regret that I am unable to be present."

NIGHT SESSION, NOVEMBER 22.

On Tuesday night one of the most pleasant social features of the Convention transpired, when a "smoker" was held in the Chamber of Commerce rooms complimentary to the visitors. The "smoker" was arranged by the local committees. Mr. J. A. Taylor, President of the Chamber of Commerce, was toastmaster. There were about 200 persons present. President Taylor introduced Captain Earl I. Brown, United States engineer in charge of this district. Captain Brown told

the assemblage something of the work that is being done in the district under his supervision under the United States Government, developing the waterways, improving the harbors, etc.

Mr. Kerr of Asheville, a member of the commission appointed to have charge of the Mattamuskeet Lake, was called upon by the toastmaster, and responded by telling something of the plans to drain not only the wet lands, but to take the water off the large area covered by the lake.

Mr. Iredell Meares, a prominent member of the local bar, responded to the call of the toastmaster in a very interesting short talk. He favored the Legislature at its next session authorizing the issuance of one million dollars in bonds for carrying forward this work. Mr. Meares would also like to see the State issue a million dollars in bonds for road work in the State.

Mr. Charles N. Evans, President of the Southern National Bank, responded for the bankers of the State, and declared that the farmers and business men could rest assured that the banks of the State would stand behind them.

Mr. B. F. Keith, Collector of Customs and one who is deeply interested in drainage, was next called upon, and said that he would be glad for the banks to come to the aid of the Lyon Swamp Drainage District, which is now advertising \$40,000 worth of bonds. Mr. Keith spoke of the value of properly draining the lands, and also spoke in favor of good roads and the stock law.

There then followed addresses from Dr. John M. Faison, Congressman from the Third District; Mr. John A. Wilkinson of Belhaven; Mr. Joseph Hyde Pratt, and Senator F. M. Simmons, all of whom spoke briefly and interestingly about drainage work.

SESSION, WEDNESDAY, NOVEMBER 23.

The closing day of the Convention began at 9:30 o'clock on Wednesday morning, November 23d, when the delegates and a large number of townspeople assembled at the wharf between Market and Princess streets, and embarked upon a trip down the Cape Fear River on the Revenue Cutter *Seminole*, in charge of Capt. R. O. Crisp. Mr. William E. Springer was chairman of the boat committee and secured the services of this cutter. There were about 150 to 200 people who enjoyed the trip, and it was undoubtedly the pleasantest feature of the entire Convention. An elegant luncheon was served on the boat by Miss Eliza French and a number of assistants.

Immediately after the luncheon the concluding business session of the Convention was held, Mr. J. A. Brown, President, presiding.

The report of the Committee on Resolutions was submitted by Congressman John H. Small, of the Second North Carolina District, and the resolutions were unanimously adopted as follows:

REPORT OF COMMITTEE ON RESOLUTIONS.

This Association was organized for the purpose of promoting the drainage of wet and overflowed lands in North Carolina. There are in this State about 2,100,000 acres of unreclaimed swamp lands, and recent investigations have shown that at least 1,000,000 acres of this land may be profitably drained and reclaimed and subjected to cultivation, which lands are exceedingly fertile and productive. It is estimated that there are, in addition, perhaps 6,000,000 acres of land now under cultivation, which are insufficiently drained, and therefore uncertain in the production of crops. These facts present a problem of vital economic importance, the solution of which should appeal to the progressive spirit of all citizens.

It is admitted that drainage lies at the basis of successful agriculture in all the coastal plain region. Even if all the other factors necessary to the production of crops should exist, they cannot be grown upon wet lands, if the drainage is insufficient.

But the promotion of agriculture and the resultant prosperity of the individual farmer is not the only purpose which would be subserved. Drainage affects at least two vital public conditions. The conservation of the public health is now universally recognized as one of the chief functions of the State. The elimination of preventable diseases and the maintenance of normal health in the individual means vitality and efficiency which are essential to economic growth and progress in all lines. The drainage of our wet lands is the primary essential in the conservation of the public health. The people of the State are now pressing with unprecedented activity a movement for better highways. We are beginning to realize the important relation of good public roads to industrial growth and commercial expansion. No substantial and permanent highway can be constructed unless drainage is provided. Therefore, the public health and improved roads must wait upon drainage.

Every thoughtful citizen who is acquainted with our abundant resources must admit the necessity of attracting the right sort of settlers and home builders to our State. The tidewater section in North Carolina alone could provide homes for a population manifold in excess of the present number, and this added population would make for the greater prosperity of all. If we would attract home-seekers from the West and other desirable classes, we must offer them fertile lands, healthful conditions, good public roads, and good public schools. We are waging a successful crusade against ignorance, and it is within our power to provide the other essentials. We again repeat that drainage is a primary necessity, without which we can neither have the most productive lands, improved public health, better highways, nor the most desirable immigrants.

Resolved, That this Association request the Trustees of the State Agricultural and Mechanical College to make provision for a complete course of drainage engineering, and we commend to the young men of the State who are pursuing the study of agriculture, that they include in their course the essential problems of drainage. The President and Secretary of this Association are hereby directed to present a copy of this resolution, in person, if possible, to an early meeting of the Trustees of the A. and M. College.

Resolved, That this Association unreservedly commend the law authorizing the teaching of agriculture in the public schools, and especially in the rural districts, and we urge that some of the elementary principles connected with drainage be included in the agricultural course. To this end, we request the State Superintendent of Public Instruction to communicate with the county superintendents and, through them, with the teachers and district committees. The President and Secretary of this Association are directed to present this resolution to the State Superintendent of Public Instruction, and, through him, to the next session of the Legislature.

Resolved, That the Legislature be requested to enact legislation which shall relieve drainage bonds from all taxation, State, county, or municipal, for a period of fifteen years, provided the Legislature has the constitutional power to enact such a law. We refer to all bonds which may be issued during the next fifteen years. We are advertent to the inhibition against exemption from taxation of private property, but we submit that these bonds are excluded from such prohibited class. Drainage is more than a semi-public function. The public health and the construction of highways are exclusively within the province of the State, and both are substantially, if not entirely, subserved and promoted by drainage. Whatever is lost in the way of public revenue will be more than met by the increased value of lands added to the taxable property. We are constrained to regard this legislation of paramount importance in the successful organization and establishment of drainage districts throughout the State. The President and Secretary of the Association are directed to present this resolution to the next session of the Legislature, through the appropriate committees of both houses, and the President is authorized to appoint any additional members of the Association to join in the presentation and the promotion of such a law.

Resolved, That we urge the Legislature, at the next session, to enact a law authorizing the State Geological and Economic Survey to employ a competent drainage engineer, under the supervision of the State Geologist, who may be employed in visiting sections where drainage is contemplated, and confer with the landowners and make preliminary investigations, with a view to determining whether the said lands are susceptible of drainage, and within a limit of cost which would constitute a profitable investment, such investigation to be preliminary to the institution of a proceeding for the establishment of a drainage district, and that the necessary appropriation be made to meet the expenditure involved. We also urge the Legislature to appropriate a sufficient fund out of which may be paid the compensation of the drainage engineer, as provided in section 2 of the General Drainage Law of 1909, the said sum so advanced to be subsequently refunded.

The President and Secretary of the Association are directed to present this resolution at the next session of the Legislature, through the appropriate committees of both houses.

Resolved, That the State Department of Agriculture be earnestly requested to establish a demonstration farm at some point where the alluvial soil exists, with a view to demonstrating the productive capacity of the soil for the various crops.

The President and Secretary of the Association are directed to present this resolution to and continue to urge the same upon the attention of the Department of Agriculture.

Resolved, That this Association, on behalf of the people of North Carolina, express deep gratitude to the United States Department of Agriculture, and particularly to the Bureau of Drainage Investigations of that Department, for the most helpful assistance and coöperation with the State of North Carolina in the making of preliminary investigations and surveys, and for expert advice in the solution of many drainage problems. That the Secretary of the Association be directed to communicate a copy of this resolution to Hon. James Wilson, Secretary of Agriculture, and to Dr. C. G. Elliott, Chief of Drainage Investigations.

Resolved, That the thanks of the Association be tendered to the Secretary of the Treasury and the Chief of the Revenue Cutter Service for the courtesy extended in placing the revenue cutter "*Seminole*" at the disposition of the local committee, and providing a most delightful trip down the Cape Fear River and to various points of interest.

That we extend thanks to the Board of County Commissioners of New Hanover County for the use of the commodious and comfortable courtroom for the sessions of this Convention. That we also extend most grateful thanks to the Chamber of Commerce, the local committee and the citizens of Wilmington, for the many and delightful courtesies extended to the members of the Association, which have contributed in such large degree to a successful session and to the pleasure of the delegates. That we cannot forget the obligations which we owe to the press of the city of Wilmington and also of the State, in reporting the proceedings of this Convention. Publicity and agitation are necessary in furthering this great public movement, in which the press must be a most valuable auxiliary.

Respectfully submitted.

JOHN H. SMALL, *Chairman*;

A. B. CROOM, JR.,

J. S. MANN,

W. S. PRIVOTT,

W. C. STINSON.

Next was the report of the Committee on Membership. Mr. Joseph Hyde Pratt, Secretary, reported for this committee, stating that there were 115 delegates registered for this Convention, but that there were 200 in attendance, some neglecting to register. The registration books show that 23 counties were represented, with one person from Virginia and another from Georgia.

REPORT OF COMMITTEE ON NOMINATIONS.

The Committee on Nominations and Next Meeting Place next made its report through Dr. John M. Faison, Congressman from the Third District. Elizabeth City was recommended as the next place of meeting, the date being left with the Secretary and Treasurer; and officers for the ensuing year were recommended as follows:

President—J. A. BROWN, Chadbourn.

Secretary and Treasurer—JOSEPH HYDE PRATT, Chapel Hill.

Vice Presidents, one from each of the counties which have become interested in drainage:

Bladen County—O. L. CLARK, Clarkton.
Beaufort—JOHN WILKINSON, Belhaven.
Brunswick—JACKSON JOHNSON, Town Creek.
Camden—W. G. FEREBEE, Gregory.
Carteret—W. S. CHADWICK, Beaufort.
Columbus—D. B. BOUGHNOB, Chadbourne.
Craven—C. R. THOMAS, New Bern.
Currituck—A. B. LUKENS, Moyock.
Greene—D. M. PATRICK, Snow Hill.
Guilford—E. W. MYERS, Greensboro.
Harnett—H. L. GODWIN, Dunn.
Jones—J. H. BELL, Pollocksville.
New Hanover—B. F. KEITH, Wilmington.
Hyde—J. S. MANN, Middletown.
Onslow—E. M. KOONCE, Jacksonville.
Pamlico—G. T. FARNELL, Bayboro.
Pasquotank—DR. L. S. BLADES, Elizabeth City.
Hertford—R. C. BRIDGER, Winton.
Chowan—S. C. PRIVOTT, Edenton.
Gates—A. P. GODWIN, Gatesville.
Pender—A. B. CROOM, JR., Burgaw.
Bertie—FRANCIS D. WINSTON, Windsor.
Robeson—J. B. SELLERS, Lumberton.
Duplin—G. M. HOUSTON, Chinquapin.
Sampson—GEORGE L. PETERSON, Clinton.
Martin—HARRY STUBBS, Williamston.
Cumberland—H. B. DOWNING, Cedar Creek.
Lincoln—R. M. ROSEMAN, Lincolnton.
Tyrrell—JOHN PINNER, East Lake.
Pitt—BURT JAMES, Greenville.
Washington—VAN BUREN MARTIN, Plymouth.
Edgecombe—H. A. GILLIAM, Tarboro.
Halifax—PAUL KITCHIN, Scotland Neck.
Perquimans—E. E. EVERETT, Hertford.
Anson—E. E. BARRETT, Polkton.
Forsyth—A. H. ELLER, Winston.
Rockingham—R. P. RICHARDSON, Reidsville.
Iredell—JAMES B. ARMFIELD, Statesville.

This entire report was unanimously adopted.

A motion was made and seconded that the President of the Association should appoint a Legislative Committee to work for the adoption of the legislation recommended in the resolutions. This was unanimously passed. The President appointed the following committee:

JOHN H. SMALL, Washington, N. C.

A. B. LUKENS, Moyock, N. C.

JOHN P. KERR, Asheville, N. C.

JOSEPH HYDE PRATT, Chapel Hill, N. C.

J. S. MANN, Middletown, N. C.

IREDELL MEARES, Wilmington, N. C.

LAWRENCE BRETT, Wilson, N. C.

S. S. MANN, Swan Quarter, N. C.

A. B. CROOM, JR., Burgaw, N. C.

JOHN WILKINSON, Belhaven, N. C.

The following excerpt from the *Wilmington Morning Star*, November 23, 1910, gives briefly the work and objects of this Convention:

OUR DRAINAGE MOVEMENT.

The Convention of the North Carolina Drainage Association, which met in Wilmington yesterday, will serve to emphasize the importance of drainage from one end of the State to the other. The interest in the movement has greatly increased since its organization three years ago, and not only the swamp counties, but the Piedmont and even the mountain counties have representatives in attendance upon the Wilmington Convention. It is being realized that the mountain lands and the bottom lands of the Piedmont country also need drainage and reclamation in a great many instances, and after this Convention completes its work the question will assume even greater importance throughout the State than it has in the history of the Commonwealth. The papers all over North Carolina have contained articles on the North Carolina drainage movement and concerning the meeting of the Association in Wilmington, and even outside the State the matter has attracted a great deal of attention and created comment. The *Norfolk Virginian-Pilot* of Monday says:

"The North Carolina Drainage Association, which will meet in convention at Wilmington this week, is doing a great and valuable work for the Old North State. The primary object of this Association is to encourage and facilitate the reclamation by drainage of vast areas of swamp and water-soaked lands in different sections of the Commonwealth. Already thousands of acres of highly fertile but hitherto untillable lands have so been added to the State's arable area, while the various drainage schemes now under consideration embrace, in the aggregate, hundreds of thousands of additional acres. In addition to this, the Association's efforts are to be directed to draining properly areas now under cultivation, but improperly drained, and so to increase the productivity of such lands. The result is bound to be increased wealth and accelerated prosperity, not only for the sections immediately affected, but for the Commonwealth at large. In its effort to solve the reclamation problem North Carolina is setting an example which some of her

Southern sisters are already following and which all would do well to imitate. The matter is one which properly comes within the jurisdiction of the several States as such and which the several States as such should and are competent to handle."

One of the results of this Convention will be the organization of quite a number of drainage districts, provided for in an act passed by the General Assembly of North Carolina at its last session two years ago. This act enables communities or districts to coöperate in the organization of "drainage districts," which can issue bonds and thus finance their drainage projects. Otherwise, sufficient capital could not be secured in communities or by individuals to carry on drainage projects on a more extensive scale than could be undertaken by private individuals. It is a good law and will prove exceedingly valuable to the State, as owing to private and State ownership of lands the National Government cannot aid in these local projects.

Besides the importance of reclaiming fertile bottom and swamp lands and generally benefiting such lands as can utilize the drains and terracing, the drainage districts will put on the market a good class of securities at good interest. These drainage bonds will furnish good collateral for loans or investments by local capitalists and banks, while the projects generally will give employment to a large number of hands. Drainage is decidedly a progressive movement, and we are laying great store by it as a factor in developing eastern North Carolina.

TILE DRAINAGE.

By J. R. HASWELL, ASSISTANT DRAINAGE ENGINEER,
U. S. DEPARTMENT OF AGRICULTURE.

A year ago, at the Second Annual Drainage Convention, an address was made on the "Practical Results of the Drainage of Farm Lands," in which for illustration the profits to be derived from reclaiming or improving three 40-acre tracts were compared. The first was a gum swamp, the second an open marsh or pocoson, and the last a poorly drained farm. The estimates showed that the improved drained farm would clear over \$10,000 in five years, and the reclaimed swamps less than one-half that amount. These comparisons show that the drainage of wet farm lands brings surer results and quicker returns.

In order to help North Carolina drain the swamps within its borders and to improve the creeks so that surface water will be taken off, the United States Department of Agriculture has taken up sixteen projects and spent \$20,000. Thus far there have been twenty-one drainage districts formed. The area tributary to the outlet canals amounts to over 500,000 acres.

OUTLETS, OPEN DITCHES, AND UNDERDRAINAGE.

These large canals and open ditches remove the surface water and reduce flooding, but only take the soil water from a narrow strip of land along their banks. Their greatest use is to serve as outlets for farm drains which extend back and completely cover the wet areas. Open ditches take up considerable farm land, are hard to keep in repair, cause trouble with farm operations, and are a source of danger to live stock.

The inconveniences of open ditches may be avoided by underdrainage, either with blind ditches of poles or stone, or by the use of tile. The latter have given the best results, and actual data obtained from the Buncombe County State Test Farm show that they cost less, in some cases, than their inferior substitutes of brush and stone.

HISTORICAL.

Tile were first used in this country by John Johnston of Seneca County, N. Y., who had learned the art of underdrainage in Scotland and had assisted in its introduction in the British Isles. He laid his tile in this country 70 years ago, and these same tile are still in use. The Middle West has made the most rapid strides in farm drainage since the profits to be obtained from it have become known. Figures for the year 1908 show North Carolina to rank lowest in the production of drain tile for those States reported, the total value being less than \$2,000, while Iowa produced over \$2,000,000 worth. This shows that North Carolina does not fully appreciate the benefits of tile drainage.

HOW TILE ACT UPON THE SOIL.

The farmer is interested in two forms of soil water, capillary and gravitational. The gravitational water is that which drowns out the crops and the capillary water is that which is needed in the upper strata of soil for growing crops. If a piece of soil is removed bodily from the ground, the gravitational water runs out and leaves the capillary water behind. This water is held by capillary attraction as paint in a paint brush. Pipes of circular form and usually one foot in length are laid in the ground, end to end, and on such a grade that the water which leaks through the joints or openings between the tiles will flow down a free outlet at a lower point. Now, as the water near the tile runs through the joints into the interior of the pipe, the water from a higher level passes down through the pores in the soil to take its place. The movement is lateral as well as downward.

The removal of the surplus water from the spaces between the soil particles makes the soil firmer and not likely to be puddled. The wetting and drying of a well-drained soil makes the particles draw together and form in crumbs or small grains. When a soil which is wet most of the time is plowed, it forms clods. The change to a granular structure is one of the most important benefits of tile drainage, as from it are derived most of the other beneficial results which apply generally to all farm crops with the exception of rice and cranberries. The drawing of the separate particles of soil together into a crumb makes more pore space in the soil, which permits of the circulation of air. Plants will not grow in a soil devoid of free oxygen.

A wet soil will not heat up so early in the spring, and the evaporation of water from its surface will make it colder throughout the growing season. This lower temperature will hasten the effects of winter, and thus we see how drainage by drying the soil warms it and thereby materially lengthens the growing season. This is of special importance in mountainous districts and greatly affects crops.

Plant food is present in much larger quantities in a drained soil. The capillary moisture held in the soil produces a greater chemical activity, without removing the products of the chemical action. This applies to the natural breaking down of the soil particles and also to commercial fertilizer. The air which the drains cause to be drawn into the soil will oxidize the minerals present and also favor the increase and growth of soil organisms which are helpful to plant growth. Poor drainage is indicated by a mottled appearance of the soil. When the level of the ground water is lowered by drainage the plants send their roots deeper, and this larger range of root zone is of great help in time of drought. The plant can draw on more soil for its moisture, the improved structure of the soil holds more moisture, and evaporation of water from the surface of the ground is reduced.

When a wet soil freezes to any great extent it heaves. This raises the plant stalk and many of the small roots are held back and broken. Successive heaving will raise a shallow-rooted plant out of the ground. This action is most excessive in a clay soil such as the red clay hills in the Piedmont region of this State.

Much of the soil in the eastern part of the State is of a light sandy nature and washes easily. Drainage, together with proper agricultural operations, will prevent much of this washing. Tile drainage causes the ground to absorb a rainfall and then carries the water away in channels that cannot wash. Deep plowing is of great assistance, as a reservoir is thus formed in the soil which will hold water till it can

seep through to the tile. By deep plowing is meant 8 or 10 inches. Greater depths than this can be obtained by using a subsoil plow which breaks up the lower foot and a half without bringing the raw material to the surface. Subsoiling is absolutely necessary in some few stiff soils if tile drainage is to be a success. Great care should be taken to subsoil when the ground is dry underneath, as in the fall of the year. The growing of green manures or the application of stable manure adds humus or organic matter to the soil which will greatly assist in absorbing a rainfall. Under proper drainage conditions a rainfall of 3 inches can all be taken up without any run-off. Terraces are used to some extent to reduce erosion, and they are an expense and inconvenience to the farmer. On the Transylvania State Test Farm the application of drainage and organic matter has made terracing unnecessary.

By draining the swamps malaria is reduced to a minimum in the community and in many cases entirely eradicated. Likewise, good drainage around the farm buildings improves the sanitary conditions greatly, the dry earth acting as a disinfectant, so that the farm animals as well as the farmer are less subject to disease.

Tile drainage, therefore, acts upon the soil as follows: By forming it into a granular or crumb-like structure it provides the soil with more oxygen, and the oxygen causes oxidization and other chemical activities which are necessary to plant growth. It warms the soil and thereby lengthens the growing season. It causes the plants to send their roots farther down, prevents heaving, and in sandy lands prevents washing. And, finally, it is conducive to better sanitary conditions.

PROFITS OF TILE DRAINAGE.

Tile drainage acting in this manner upon the soil doubles and sometimes triples the yield per acre. Cleared land which has been too wet for anything but pasture in dry years can by drainage often be made the most productive on the farm. Usually, a farmer does not have to coöperate with his neighbors in farm drainage, and he thus avoids the endless controversy which sometimes is occasioned by attempted coöperation in larger work. The increased profits from the land are his own and he leaves a heritage for which his children will never cease to thank him, provided the work is well done.

KIND OF TILE TO USE.

The most important items to be considered in tile drainage are the kind and durability of tile used. An important point in the selection of clay tile is the burning. They do not have to be vitrified, but every particle of clay should be burned. This makes the tile almost indestructible when in the ground.

This map illustrates a tile drainage system in a portion of the Pender Test Farm, located near Willard, North Carolina. The map features several key elements:

- Geographic Features:** A "Tenant House" is marked with a small square symbol. A "Dwelling" is shown as a hatched rectangle. A "Barn." is depicted as a large, L-shaped hatched structure.
- Infrastructure:** A "Property Line" is indicated by a line with cross-ticks. The "A. C. L. R. R." (Atlantic Coast Line Railroad) runs diagonally across the lower right portion of the map.
- Distances:**
 - "To Wallace 2 miles" is noted along a road at the top.
 - "To Willard 1 1/2 miles." is noted along the railroad line.
 - "To Wilmington 35 miles." is also noted along the railroad line.
- Elevation and Drainage:**
 - Surface elevations are marked with dashed lines and numbers: 526, 522, 539, 549, 544, 530, 528, 535, 540, and 549.
 - A "Fig. 2" label is associated with the 544 and 530 elevations.
 - A "Surface Elevations" label is placed near the 539 and 522 elevations.
- Scale:** A scale bar at the bottom indicates distances in feet, with markings for 200, 400, and 600 feet.
- Title:** The map is titled "MAP OF TILE DRAINAGE SYSTEM IN PART OF PENDER TEST FARM NEAR WILLARD, N. C."

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structible when in the ground.

Frequent freezing and thawing, as at the outlet, is the most destructive agency at work. Spots of free lime are a great detriment, as the lime swells and splits up the tile. Porosity is not important, as practically no water passes through the walls of the tile, and, where the ground freezes down to the tile, porosity is undesirable. The best vitrified tile, preferably sewer pipe, should be used at the outlet to withstand freezing, and the joints of the sewer pipe should be cemented to hold them together.

DEPTH AND DISTANCE APART.

The depth and distance apart of drains determine the cost of draining a given area. To secure efficient drainage the lines of tile should be laid close enough so that the strip of land drained by one line will extend laterally to the strip drained by the other. The distance between the drains depends upon the tightness of the soil. Soils are spoken of either as "tight" or "close" or "loose" and open with respect to their drainage properties. These two extremes call for a 2-foot depth and 40-foot spacing in the first case as against a 4-foot depth and 300-foot spacing in a loose, open soil.

The map of a portion of Pender Test Farm (Pl. I) shows the location of some of the drains. The spacing is 100 feet and the average depth is 3 feet. Pl. II, A, shows a typical flat in need of uniform drainage. The figures on the map show the area relating to the pictures. System G drains the foreground and the main is along the road, which is also shown on the map, running across the picture just above the middle. The laterals run directly back from the front of the picture or in a northerly direction and connect to the main at the road. The distance from the road to the woods is 300 feet and the area is drained by two parallel lines dividing the distance into three equal parts, making a 100-foot spacing. The area north of the road, *i. e.*, between it and the woods, was planted in corn twice in the spring of 1910 with practically no results. The standing water in the foreground lasted from one rain to the next. In 1910 the field was in this condition up until September.

SOIL STUDY NECESSARY TO PLAN TILE SYSTEM.

Too great a depth in a tight soil renders the tile useless, and too shallow a depth in an open soil causes an extra cost on account of the closer spacing required. In a uniform soil, the deeper the tile are placed the farther out they will drain, up to a certain limit, which is determined by the resistance the soil offers to the passage of the water. In alluvial or stratified soils this does not hold, as various strata of unequal texture will modify the application. It would be advisable to

change the depth and spacing in a small field to suit a change in the character of the soil. A joint structure in a subsoil clay renders it easily drained. A number of test pits, post holes, or auger borings should be made. A few pits are necessary in order to determine the structure, while borings can be used to determine the uniformity of the soil material throughout the area.

This study of the soil will save the farmer many dollars. A good instance of this is shown on the Buncombe Test Farm, where a line of tile a few hundred feet long and costing about \$15 tapped a bed of gravel and drained approximately 10 acres. The gravel acted as a reservoir and allowed the water to seep out on the land below. When it was tapped the 3-inch tile ran full for quite a while, and the people thought of using it as a water supply, when it suddenly ceased flowing. Irregularities of soil in the upper surface of a clay subsoil will hold water and cause wet, quicksandy places in the loose, open soils of the coast plain counties. On the Pender Test Farm a ridge of clay held back the soil water and drowned out a pecan planting and much of the corn planted between the trees. A single line of 4-inch tile 310 feet long, laid $3\frac{1}{2}$ feet deep through the ridge, will carry off the surplus water. This is shown in Pl. II, B, and on the map at line "D." The picture was taken from the windmill tower behind the superintendent's house and the camera was pointed northwest. The swale starts at the left of the picture and runs parallel to the road in the foreground. The two large pecans can be seen in the corn. The rest are dead or stunted. Line "H" runs through a similar swale. Single lines like these pay a high return on the investment.

TILE SYSTEMS.

In planning a system of drains the outlet is of most importance. This point is that to which all water from the drained area must eventually come, and on it the success of the system chiefly depends. The number of drainage districts throughout the State show that the outlet problem has been solved for a great area and all that is needed is for the farmer to realize his opportunities and to extend the system of drainage over his farm.

In rolling country the hillsides are generally thought to be naturally well drained and the long wet valleys furnish the only problems. A line of large tile laid along the lowest part of the draw will help out the natural drainage. Sharp turns and meanderings which occur in some valleys should not be followed, but straight lines joined by easy curves should be used. This will make the depth of the tile vary, but will reduce the length of line and increase the fall per 100 feet of tile.

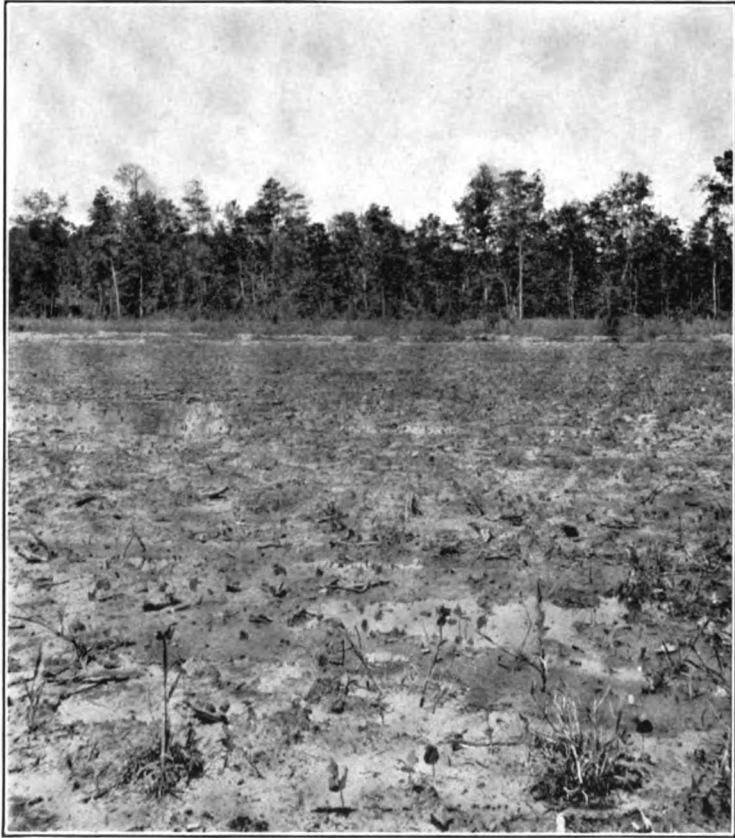


PLATE II-A. AREA REQUIRING A UNIFORM SYSTEM OF DRAINAGE.
PENDER TEST FARM, WILLARD, N. C., AUGUST, 1910.

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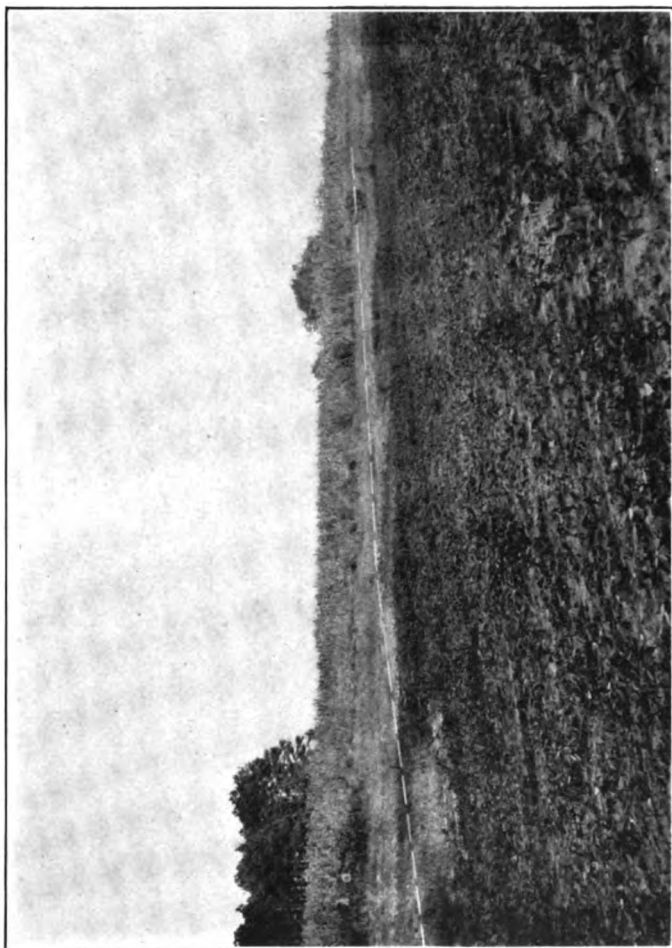


PLATE II-B. INTERCEPTING SEEP WATER FROM A HILLSIDE. LOCATION OF INTERCEPTING DRAIN SHOWN BY BROKEN WHITE LINE. PENDER TEST FARM, WILLARD, N. C., AUGUST, 1910.

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The valley may widen out so as to require several laterals parallel to the main in order to properly cover the area. This was the case in a narrow flat on the Red Crest Farm in Iredell County. On one side was a large open ditch, while the other side was too wet for use. Two, and in the wider part three, lines of tile were used. After the main has been located in the depression and the area tributary to it determined, the lateral drainage is planned.

RANDOM AND REGULAR TILE DRAINAGE.

This is done in two ways. The first is to locate branch lines to all sags, swales, ponds, etc., which are to be drained, without special regard to systematic work. This is called random field drainage. The second method is to supplement the primary network by constructing laterals parallel to each other at equal distances according to the requirements of the particular soil, acting on the theory that every part of the field requires equal drainage. The most economical system for thorough drainage is a system of parallel lines of sufficient length. This is easily seen when we consider that the soil in the neighborhood of a junction has two lines of tile working on it where only one is needed. Long parallel lines are seen at lines "E" and "F" on the map. The laterals in system "G" could not go the same way, as there was not fall enough in that direction.

As a general rule, drains should be laid up and down the slope, but in some cases a drain across the slope will accomplish the desired end at less cost. A case of this kind is where a low, wet flat receives seep water from a hill (Pl. III). A line of tile laid so as to intercept the seep water is all that is needed for drainage. Such a plan was used on the Pender Test Farm where an open ditch failed to go deep enough to intercept the water. Figure 3 was taken from near the outlet of System "I," looking east. The open ditch is along the edge of the corn and the whole slope below it was seepy. The line of tile is indicated by the dashed lines.

One frequently sees areas in a field which are surrounded by slightly higher land. This causes the water to settle toward the low spot and drown out the crop. A couple of collecting lines of 3-inch tile with a 4-inch main is all that is needed to stop the trouble. A location like this was used on the Edgcombe Test Farm. The stand of cotton over this drained sink was the best on the farm, and the net profit of the first year's crop on that area would pay for the cost of installing the tile. Previously, it had been planted and cultivated the same as the rest of the field and had drowned out each year, making a total loss for that area.

GRADES OF TILE DRAINS.

Grades should be set with a leveling instrument, by a competent engineer. The farmer should not attempt to plan a grade in any but rolling country. A farmer near here did some drainage work without a level, and when an engineer was called in to see why the tile would not work he found the outlet was one foot higher than the tile farther up the line.

It will be necessary to use flat grades on your level coastal plain, and with careful work in firm soils a grade of $\frac{1}{2}$ inch per 100 feet will insure a flow, provided the lines are not too long. When possible, 2 inches per 100 feet is the best minimum grade for safe operation.

SIZE OF TILE FOR MAINS AND LATERALS.

The size of tile to be used is a point hard to determine, and it is impossible to cover all the features here. The mains act as outlets for the laterals and their sizes depend upon the necessary rate of removing the water through both drains. In excessive storms most of the run-off passes over the surface of the ground. The size also depends upon the area drained, the retentive qualities of the soil, and the grade on which the tile is laid. The main should not equal the combined capacity of the laterals, as they seldom, if ever, run full. Five-inch tile are the smallest that should be used for mains, while 6-inch are the smallest to which surface water can be directly admitted with safety. The sizes used on the Pender Test Farm were governed by the stock on hand.

There is a line of 3-inch tile 1,300 feet long on a farm in Edgecombe County. The area drained is 11 acres. The tile runs full through most all of the wet season, and is not as great a success as it might be. Five-inch tile would have added less than \$20 to the first cost and would have more than paid for the extra expense. The smaller tile is much more likely to clog up and get out of line than a 5-inch tile.

The laterals act as collectors for the water, which the main will carry off. Their size is determined by practical operation and not by computed quantities of water to be removed. Very few 3-inch tile, and none smaller, should be used. This size is only practicable in a fairly open soil with laterals spaced 80 feet or closer. In heavy soils or where the laterals are spaced 100 feet or more, 4-inch tile should be used.

COST OF TILE DRAINAGE.

The cost of construction varies. On farms where tile in the valleys is to supplement good natural drainage on the hillsides, the cost may average only \$8 per acre for the whole farm. Where uniform drainage



PLATE III. SWALE. LAND REQUIRING RANDOM DRAINAGE.
PENDER TEST FARM, WILLARD, N. C., AUGUST, 1910.

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is required the cost may reach \$30 per acre. The time of the year at which the ditching is done greatly governs the cost. The increased profits from drainage generally pay the cost of its installation in a few years, and as an investment an annual profit of 25 per cent is not uncommon.

It has been impossible to present here the entire field of tile drainage, but for more detailed information on the subject I would refer you to Farmers' Bulletin No. 187, "Drainage of Farm Lands," which will be furnished upon request to the United States Department of Agriculture. Information may also be found in books on drainage which may be obtained from any technical supply firm.

In regard to drainage as an investment, I wish, in closing, to quote an authority upon this subject, Mr. C. G. Elliott, Chief of Drainage Investigations, who writes:

"The writer has known of many thousands of acres of land that have been drained, and has never known of an instance in which the money spent for drainage, when thoroughly done, did not pay a large return on the investment."

THE NORTH CAROLINA DRAINAGE LAW.

At the Third Annual Convention of the North Carolina Drainage Association which was held at Wilmington, North Carolina, on November 22 and 23, 1910, the principal topic of discussion was the modification of the North Carolina Drainage Law which would make it more effective and the drainage bonds more salable. At that Convention a legislative committee was appointed, composed as follows: John H. Small, Washington, N. C.; A. B. Lukens, Moyock, N. C.; J. S. Mann, Middletown, N. C.; Lawrence Brett, Wilson, N. C.; Iredell Meares, Wilmington, N. C.; S. S. Mann, Swan Quarter, N. C.; A. B. Croom, Jr., Burgaw, N. C.; John Wilkinson, Belhaven, N. C.; Joseph A. Brown, Chadbourn, N. C.; John P. Kerr, Asheville, N. C.; Joseph Hyde Pratt, Chapel Hill, N. C.

This committee held several meetings and then appointed a sub-committee to draft a bill embodying the ideas and suggestions of the committee on the whole and those embodied in the resolutions passed by the Association.

The bill representing the work of the committee was introduced in the House by Hon. W. S. Privott, Representative from Chowan County, and in the Senate by Hon. Joseph A. Brown, Senator from the Twelfth District. The bill was passed and ratified on March 3, 1911.

An error was noted in section 11, which read that the commissioners authorized to use bond issue "to the payment of the interest on said bonds for the two years next following the date of issue," and it should have read "to the payment of the interest on said bonds for the *three* years next following the date of issue." This necessitated a supplemental act making this change, which was introduced by Senator Brown, and passed and ratified on the 8th of March.

A separate bill was introduced by Hon. W. S. Privott, exempting the drainage bonds from taxation for a period of fifteen years. This bill, as passed, exempts drainage bonds for the period of fifteen years from county and municipal taxation.

There is given below the North Carolina Drainage Law as it is in force.

The principal amendments to the law of 1909 are:

Regarding issuance of bonds and payment of interest thereon.

Exempting drainage bonds from taxation.

Fees allowed sheriff and treasurer handling drainage district funds.

Payment of compensation expenses of drainage engineer for preliminary report.

Sale of land on account of nonpayment by owner of drainage assessment.

Agreement of time between railway company and drainage commissioners regarding going under railway with canal.

Regarding maintenance of bridges that have to be constructed across drainage canal.

Method of letting contract.

In order that those who are interested in drainage districts in North Carolina may have the North Carolina Drainage Law in a form convenient for use, there is given below the law codified to date and annotated. That portion of the law passed by the General Assembly of 1909 is given in ordinary type and the amendments of 1911 are given in italics. The chapter, section, and year where the original act can be found are given after each section or paragraph.

NORTH CAROLINA DRAINAGE LAW

(CODIFIED).

AN ACT TO PROMOTE THE PUBLIC HEALTH, CONVENIENCE AND WELFARE BY LEVEEING, DITCHING AND DRAINING THE WET, SWAMP AND OVERFLOWED LANDS OF THE STATE, AND PROVIDING FOR THE ESTABLISHMENT OF LEVEE OR DRAINAGE DISTRICTS FOR THE PURPOSE OF ENLARGING OR CHANGING ANY NATURAL WATER COURSES, AND FOR DIGGING DITCHES OR CANALS FOR SECURING BETTER DRAINAGE OR PROVIDING BETTER OUTLETS FOR DRAINAGE, FOR BUILDING LEVEES OR EMBANKMENTS AND INSTALLING TIDE GATES OR PUMPING PLANTS FOR THE RECLAMATION OF OVERFLOWED LANDS, AND PRESCRIBING A METHOD FOR SO DOING; AND PROVIDING FOR THE ASSESSMENT AND COLLECTION OF THE COST AND EXPENSE OF THE SAME, AND ISSUING AND SELLING BONDS THEREFOR, AND FOR THE CARE AND MAINTENANCE OF SUCH IMPROVEMENTS, WHEN CONSTRUCTED.

The General Assembly of North Carolina do enact:

SECTION 1. *Duty and powers of the court.*

Jurisdiction of clerk of superior court.

Levee or drainage districts.

Drainage a public benefit.

The clerk of the Superior Court of any county in the State of North Carolina shall have jurisdiction, power and authority to establish a levee or drainage district or districts in his county, and to locate and establish levees, drains or canals, and cause to be constructed, straightened, widened or deepened any ditch, drain or water course, and to build levees or embankments and erect tide gates and pumping plants for the purpose of draining and reclaiming wet, swamp or overflowed lands; and it is hereby declared that the drainage of swamps and the drainage of the surface water from agricultural lands and the reclamation of tidal marshes shall be considered a public benefit and conducive to the public health, convenience, utility and welfare.

c. 442 (1), 1900.

SEC. 2. *Petition—Bond—Board of viewers.*

Petition for establishment of drainage district.

Whenever a petition signed by a majority of the resident land-owners in a proposed drainage district or by the owners of three-fifths of all the land which will be affected by or assessed for the expense of the proposed improvements shall be filed in the office of the clerk of the Superior Court of any county in which a part of said lands are located, setting forth that any specific body or district of land in the county and adjoining counties, described in such a way as to convey an intelligent idea as to the location of such land, is subject to overflow or too wet for cultivation, and the public benefit or utility or the public health, convenience or welfare will be promoted by draining, ditching or leveeing the same.

or by changing or improving the natural water courses, and setting forth therein, as far as practicable, the starting point, route and terminus and lateral branches, if necessary, of the proposed improvement, and there is filed therewith a bond for the amount of fifty dollars per mile for each mile of the ditch or proposed improvement, signed by two or more sureties or by some lawful and authorized surety company, to be approved by the clerk of the Superior Court and conditioned for payment of all costs and expenses incurred in the proceedings in case the court does not grant the prayer of said petition, the said clerk shall issue a summons to be served on all the defendant landowners who have not joined in the petition and whose lands are included in the proposed drainage district. Upon the return day the said clerk shall appoint a disinterested and competent civil and drainage engineer and two resident freeholders of the county or counties in which said lands are located as a board of viewers to examine the lands described in the petition and make a preliminary report thereon. Such drainage engineer shall be appointed upon the recommendation of the State Geologist, and the compensation for the services of such engineer and his necessary assistants, to be fixed as herein provided, shall be paid by the State Geological and Economic Survey, said sum or sums so paid to be refunded when the drainage fund is subsequently provided by the sale of bonds or otherwise. When the lands proposed to be drained and created into a drainage district are located in two or more counties the clerk of the Superior Court of either county shall have and exercise the jurisdiction herein conferred, and the venue shall be in that county in which the petition is first filed. The law and rules regulating special proceedings shall be applicable to this act, so far as may be practicable. The summons may be served by publication as to any defendants who cannot be personally served as provided by law.

Bond for cost of proceedings.

Summons to be served on landowners.

Appointment of board of viewers.

Appointment and payment of drainage engineer.

Jurisdiction when land is in more than one county.

Rules of proceeding.

Summons served by publication.

c. 442 (2), 1909.

If at the time of the filing of the petition, or at any time subsequent thereto, it shall be made to appear to the court by affidavit or otherwise that the owner or owners of the whole or any share of any tract or tracts of land whose names are unknown, and cannot after due diligence be ascertained by the petitioners, the court shall order a notice in the nature of a summons to be given to all such persons by a publication of the petition, or of the substance thereof, and describing generally the tract or tracts of land as to which the owner or owners are unknown, with the order of the court thereon, in some newspaper published in the county wherein the land is located, or in some other county, if no newspaper shall be published in the first-named county, which newspaper or newspapers shall be designated in the order of the court, and a copy of such publication shall also be posted in at least three conspicuous places within the boundaries of the proposed district, and at the courthouse door of the county. Such publication in a newspaper and by posting shall be made for a period of four weeks. After

Publication of petition and description of land of unknown owners.

Court assumes jurisdiction. *the time of publication shall have expired, if no person claiming and asserting title to the tract or tracts of land and entitled to notice shall appear, the court in its discretion may appoint some disinterested person to represent the unknown owner or owners of said lands, and thereupon the court shall assume jurisdiction of the said tract or tracts of land and shall adjudicate as to the said lands to the same extent as if the true owners were present and represented, and shall proceed against the land itself. If at any time during the pendency of the drainage proceeding the true owner or owners of the lands shall appear in person, they may be made parties defendant of their own motion and without the necessity of personal service, and shall thereafter be considered as parties to the proceeding, but they shall have no right to except to or appeal from any order or judgment theretofore rendered, as to which the time for filing exceptions on notice shall have expired.*

c. 67 (1), 1911.

Payment of compensation of engineers. *• That the State Treasurer shall pay the compensation and expenses of the drainage engineer and his necessary assistants as provided in section two of chapter four hundred and forty-two of the General Laws of one thousand nine hundred and nine, according to an itemized statement approved by the clerk of the court to whom the petition for a drainage district was made, and the State Geologist, upon warrant of the State Auditor, out of any money in the State Treasury to the credit of the Department of Agriculture: Provided, that said sum or sums shall be refunded to the State Treasury to the credit of the Department of Agriculture by the petitioners for the drainage district if the drainage district is not established: Provided further, that if the drainage district is established said sum or sums shall be refunded to the State Treasury to the credit of the Department of Agriculture out of the first moneys received from the sale of the bonds of said drainage district: Provided, that the total amount loaned by the State Treasury, out of the funds to the credit of the Department of Agriculture, for the purpose set forth in this section, shall never exceed fifteen thousand dollars (\$15,000) at any one time: Provided further, that not more than two thousand dollars shall be advanced to any one district; and Provided further, that before any advancement is made for the purposes herein expressed, the bond of the petitioners required by section two of said chapter shall be first approved by the Attorney-General.*

c. 67 (14), 1911.

SEC. 3. Examination—Preliminary report.

Board of viewers to examine lands and route. *The board of viewers shall proceed to examine the land described in said petition, and other land if necessary to locate properly such improvement or improvements as are petitioned for, along the route described in the petition, or any other route answering the same purpose if found more practicable or feasible, and may make surveys such as may be necessary to determine the boundaries and elevation of the several parts of the district, and shall make and*

Surveys.

return to the clerk of the Superior Court within thirty days, unless the time shall be extended by the court, a written report, which shall set forth:

1. Whether the proposed drainage is practicable or not.
2. Whether it will benefit the public health or any public highway or be conducive to the general welfare of the community.
3. Whether the improvement proposed will benefit the lands sought to be benefited.
4. Whether or not all the lands that are benefited are included in the proposed drainage district.

Report to set forth:
If drainage is practicable:
If drainage will benefit public health or any public highway or conduce to general welfare:
If drainage will benefit the specific lands:
If all lands to be benefited are included.

They shall also file with this report a map of the proposed drainage district, showing the location of the ditch or ditches or other improvement to be constructed and the lands that will be affected thereby, and such other information as they may have collected that will tend to show the correctness of their findings.

Map to be filed.
Other information.

c. 442 (3), 1900.

SEC. 4. *Filing preliminary report.*

The clerk of the Superior Court shall consider this report. If the viewers report that the drainage is not practicable or that it will not benefit the public health or any public highway or be conducive to the general welfare of the community, and the court shall approve such findings, the petition shall be dismissed at the cost of the petitioners. Such petition or proceeding may again be instituted by the same or additional landowners at any time after six months, upon proper allegations that conditions have changed or that material facts were omitted or overlooked. If the viewers report that the drainage is practicable and that it will benefit the public health or any public highway or be conducive to the general welfare of the community, and the court shall so find, then the court shall fix a day when the report will be further heard and considered.

Clerk to consider report.
Petition dismissed if work not reported practicable and beneficial.
Petition renewed after six months.
Day for further hearing if report be favorable.

c. 442 (4), 1900.

SEC. 5. *Notice.*

If the petition is entertained by the court, notice shall be given by publication for two consecutive weeks in some newspaper of general circulation within the county or counties, if one shall be published in such counties, and also by posting a written or printed notice at the door of the courthouse and at five conspicuous places within the drainage district that on the date set, naming the day, the court will consider and pass upon the report of the viewers. At least fifteen days shall intervene between the date of the publication and the posting of the notices and the date set for the hearing.

Notice of hearing.
Time of notice.

c. 442 (5), 1900.

SEC. 6. *Hearing preliminary report.*

At the date appointed for the hearing the court shall hear and determine any objections that may be offered to the report of the

Court to hear and determine objections.

Amendments to petition and changes in boundary and location.

viewers. If it appears that there is any land within the proposed levee or drainage district that will not be affected by the leveeing or drainage thereof, such lands shall be excluded and the names of the owners withdrawn from such proceeding; and if it shall be shown that there is any land not within the proposed district that will be affected by the construction of the proposed levee or drain, the boundary of the district shall be so changed as to include such land, and such additional landowners shall be made parties plaintiff or defendant, respectively, and summons shall issue accordingly, as hereinbefore provided. After such change in the boundary is made, the sufficiency of the petition shall be verified, to determine whether or not it conforms to the requirements of the statute as provided in section two. The efficiency of the drainage or levees may also be determined, and if it appears that the location of any levee or drain can be changed so as to make it more effective, or that other branches or spurs should be constructed, or that any branch or spur projected may be eliminated or other changes made that will tend to increase the benefits of the proposed work, such modification and changes shall be made by the board. The engineer and the other two viewers may attend this meeting and give any information or evidence that may be sought to verify and substantiate their report. If necessary, the petition, as amended, shall be referred by the court to the engineer and two viewers for further report. The above facts having been determined to the satisfaction of the court, and the boundaries of the proposed district so determined, it shall declare the establishment of the drainage or levee district, which shall be designated by a name or number, for the object and purpose as herein set forth.

Board of viewers may attend hearing.
Reference of petition for further report.
Establishment of district.

Name or number.

c. 442 (6), 1909.

Lands excluded from district.

If any lands shall be excluded from said district because of the court having found that such lands will not be affected or benefited, and the names of the owners of such lands have been withdrawn from such proceeding, but such lands are so situated as necessarily to be located within the outer boundaries of said district, such fact shall not prevent the establishment of the district, and said lands shall not be assessed for any drainage tax; but this shall not prevent the district from acquiring a right of way across such lands for constructing a canal or ditch or for any other necessary purpose authorized by law.

Right of way across such lands.

c. 67 (2), 1911.

SEC. 7. May condemn land.

Power to condemn land.

If it shall be necessary to acquire a right of way or an outlet over and through lands not affected by the drainage, and the same cannot be acquired by purchase, then and in such event the power of eminent domain is hereby conferred, and the same may be condemned. Such owner or owners of the land proposed to be condemned may be made parties defendant in the manner of an ancillary proceeding, and the procedure shall be substantially as provided for the condemnation of rights of way for railroads in

Procedure for condemnation.

chapter sixty-one of the Revisal of one thousand nine hundred and five, so far as the same may be applicable, and such damages as may be awarded as compensation shall be paid by the board of drainage commissioners out of the first funds which shall be available from the proceeds of sale of bonds or otherwise.

c. 442 (7), 1909.

SEC. 8. *Right of appeal.*

Any person or corporation owning lands within the drainage or levee district which he or it thinks will not be benefited by the improvement and should not be included in the district may appeal from the decision of the court to the Superior Court of such county, in term-time, by filing an appeal, accompanied by a bond, conditioned for the payment of the costs if the appeal should be decided against him, for such sum as the court may require, not exceeding two hundred dollars, signed by two or more solvent sureties, or in some approved surety company, to be approved by the court.

c. 442 (8), 1909.

SEC. 9. *Complete survey.*

After the district is established the court shall refer the report of the engineer and viewers back to them to make a complete survey, plans and specifications for the drains or levees or other improvements, and fix a time when said engineer and viewers shall complete and file their report, not exceeding sixty days.

c. 442 (9), 1909.

SEC. 10. *Complete report.*

The engineer and viewers shall have power to employ such assistants as may be necessary to make a complete survey of the drainage district, and shall enter upon the ground and make a survey of the main drain or drains and all its laterals. The line of each ditch, drain or levee shall be plainly and substantially marked on the ground. The course and distance of each ditch shall be carefully noted and sufficient notes made, so that it may be accurately platted and mapped. A line of levels shall be run for the entire work and sufficient data secured from which accurate profiles and plans may be made. Frequent bench marks shall be established along the line, on permanent objects, and their elevation recorded in the field books. If it is deemed expedient by the engineer and viewers, other levels may be run to determine the fall from one part of the district to another. If an old water course, ditch or channel is being widened, deepened or straightened, it shall be accurately cross-sectioned, so as to compute the amount of cubic yards saved by the use of such old channel. A drainage map of the district shall then be completed, showing the location of the ditch or ditches and other improvements and the boundary, as closely as may be determined by the records of the lands owned by each individual landowner within the district. The location of any railroads or public highways and the boundary of any incorporated towns or villages within the district shall

Payment of damages.

Appeal to superior court.

Bond on appeal.

Report referred for complete survey.

Complete report within sixty days.

Board of viewers may employ assistants.

Survey of main drain and laterals.

Detailed instructions for making survey.

Drainage map to be drawn. Details of map.

Profile to accompany map.

be shown on the map. There shall also be prepared to accompany this map a profile of each levee, drain or water course, showing the surface of the ground, the bottom or grade of the proposed improvement and the number of cubic yards of excavation or fill in each mile or fraction thereof, and the total yards in the proposed improvement and the estimated cost thereof, and plans and specifications, and the cost of any other work required to be done.
c. 442 (10), 1909.

Estimate of cost. Plans, specifications and cost of other work.

SEC. 11. *Assessment of damages.*

Board of viewers to assess claims for damages.

It shall be the further duty of the engineer and viewers to assess the damages claimed by any one that is justly right and due to them for land taken or for inconvenience imposed because of the construction of the improvement, or for any other legal damages sustained. Such damage shall be considered separate and apart from any benefit the land would receive because of the proposed work, and shall be paid by the board of drainage commissioners when funds shall come into their hands.

c. 442 (11), 1909.

Benefits not considered.

Payment of damages.

SEC. 12. *Classification of land according to benefits.*

Board of viewers to examine and classify lands.

It shall be the further duty of the engineer and viewers to personally examine the land in the district and classify it with reference to the benefit it will receive from the construction of the levee, ditch, drain or water course or other improvement. In the case of drainage, the degree of wetness of the land, its proximity to the ditch or a natural outlet and the fertility of the soil shall be considered in determining the amount of benefit it will receive by the construction of the ditch. The land benefited shall be separated into five classes. The land receiving the highest benefit shall be marked "Class A"; that receiving the next highest benefit, "Class B"; that receiving the next highest benefit, "Class C"; that receiving the next highest benefit, "Class D," and that receiving the smallest benefit, "Class E." The holdings of any one landowner need not necessarily be all in one class, but the number of acres in each class shall be ascertained, though its boundary need not be marked on the ground or shown on the map. The total number of acres owned by one person in each class and the total number of acres benefited shall be determined. The total number of acres of each class in the entire district shall be ascertained and presented in tabulated form. The scale of assessment upon the several classes of land returned by the engineer and viewers shall be in the ratio of five, four, three, two and one; that is to say, as often as five mills per acre is assessed against the land in "Class A," four mills per acre shall be assessed against the land in "Class B," three mills per acre in "Class C," two mills per acre in "Class D," and one mill per acre in "Class E." This shall form the basis of the assessment of benefits to the lands for drainage purposes.

c. 442 (12), 1909.

Considerations in determining benefit.

Land in five classes, "A," "B," "C," "D," and "E."

Number of acres in each class ascertained.

Total acreage.

Scale of assessment.

SEC. 13. *Cost of the survey.*

The engineer and viewers shall keep an accurate account and report to the court the name and number of days each person was employed on the survey and the kind of work he was doing and any expenses that may have been incurred in going to and from the work, and the cost of any supplies or material that may have been used in making the survey.

c. 442 (13), 1909.

SEC. 14. *Delay—Extension of time.*

In case the work is delayed by high water, sickness or any other good cause, and the report is not completed at the time fixed by the court, the engineer and viewers shall appear before the court and state in writing the cause of such failure and ask for sufficient time in which to complete the work, and the court shall set another date by which the report shall be completed and filed.

c. 442 (14), 1909.

SEC. 15. *Final report—Notice of hearing.*

When the final report is completed and filed it shall be examined by the court, and if it is found to be in due form and in accordance with the law it shall be accepted, and if not in due form it may be referred back to the engineer and viewers, with instructions to secure further information, to be reported at a subsequent date to be fixed by the court. When the report is fully completed and accepted by the court a date not less than twenty days thereafter shall be fixed by the court for the final hearing upon the report, and notice thereof shall be given by publication in a newspaper of general circulation in the county and by posting a written or printed notice on the door of the courthouse and at five conspicuous places throughout the district, such publication to be made for at least two weeks before the final hearing. During this time a copy of the report shall be on file in the office of the clerk of the Superior Court and shall be open to the inspection of any landowner or other person interested within the district.

c. 442 (15), 1909.

SEC. 16. *Adjudication—Final report.*

At the date set for hearing any landowner may appear in person or by counsel and file his objection in writing to the report of the viewers; and it shall be the duty of the court to carefully review the report of the viewers and the objections filed thereto, and make such changes as are necessary to render substantial and equal justice to all the landowners in the district. If, in the opinion of the court, the cost of construction, together with the amount of damages assessed, is not greater than the benefits that will accrue to the land affected, the court shall confirm the report of the viewers. If, however, the court finds that the cost of construction, together with the damages assessed, is greater than the resulting benefit that will accrue to the lands affected, the court shall dismiss the proceedings at the cost of the petitioners, and the sureties upon the bond so filed by them shall be liable for such

Account kept and reported to court.

Court may extend time for cause shown.

Examination of final report.

Time for final hearing.

Notice of final hearing.

Time of publication. Report open to inspection.

Landowners may appear in person or by counsel. Objections in writing. Court to review report and objections. Confirmation of report.

Dismissal of proceedings.

Proviso: release of costs of engineer and assistants.

Payments on costs.

costs: *Provided*, that the State Geological and Economic Survey may remit and release to the petitioners the costs expended by said board on account of the engineer and his assistants. The court may from time to time collect from the petitioners such amounts as may be necessary to pay costs accruing, other than costs of the engineer and his assistants, such amounts to be repaid from the special tax hereby authorized.

c. 442 (16), 1909.

SEC. 17. *Appeal.*

Appeal to superior court.

Any party aggrieved may, within ten days after the confirmation of the assessor's report, appeal to the Superior Court in term-time. Such appeal shall be taken and prosecuted as now provided in special proceedings.

c. 442 (17), 1909.

Appeal heard only upon exceptions.

Such appeal shall be based and heard only upon the exceptions theretofore filed by the complaining party, either as to issue of law or fact, and no additional exceptions shall be considered by the court upon the hearing of the appeal.

c. 67 (3), 1911.

SEC. 18. *Drainage record.*

Drainage record.

The clerk of the Superior Court shall provide a suitable book, to be known as the "Drainage Record," in which he shall transcribe every petition, motion, order, report, judgment or finding of the board in every drainage transaction that may come before it, in such a manner as to make a complete and continuous record of the case. Copies of all the maps and profiles are to be furnished by the engineer and marked by the clerk "Official Copies," which shall be kept on file by him in his office, and one other copy shall be pasted or otherwise attached to his record book.

c. 442 (18), 1909.

Board of drainage commissioners.

Election by landowners.

Appointment by court.

Vacancies.

Drainage commissioners incorporated.

Corporate name.

Corporate powers.

Organization.

SEC. 19. After the said drainage district shall have been declared established, as aforesaid, and the survey and plan therefor approved, the court shall appoint three persons, who shall be designated as the board of drainage commissioners. Such drainage commissioners shall first be elected by the owners of land within the drainage or levee district, or by a majority of same, in such manner as the court shall prescribe. The court shall appoint those receiving a majority of the votes. If any one or more of such proposed commissioners shall not receive the vote of a majority of such landowners the court shall appoint all or the remainder from among those voted for in the election. Any vacancy thereafter occurring shall be filled in like manner. Such three drainage commissioners, when so appointed, shall be immediately created a body corporate under the name and style of "The Board of Drainage Commissioners of District," with the right to hold property and convey the same, to sue and be sued, and shall possess such other powers as usually pertain to corporations. They shall organize by electing from among their num-

ber a chairman and a vice chairman. They shall also elect a secretary, either within or without their body. The treasurer of the county in which the proceeding was instituted shall be *ex officio* treasurer of such drainage commissioners. Such board of drainage commissioners shall adopt a seal, which they may alter at pleasure. The board of drainage commissioners shall have and possess such powers as are herein granted. The name of such drainage district, whether designated by number or otherwise, shall constitute a part of its corporate name; for illustration, "The Board of Drainage Commissioners of (No. 1 or Moyock) District."

c. 442 (19), 1909.

SEC. 20. *Superintendent of construction.*

The board of drainage commissioners shall appoint a competent person as superintendent of construction. Such person shall furnish a bond, to be approved by the commissioners, in the penal sum of ten thousand dollars, conditioned upon the honest and faithful performance of his duties, such bond to be in favor of the board of drainage commissioners.

c. 442 (20), 1909.

SEC. 21. *Notice of letting contract—Bond.*

The board of drainage commissioners shall cause notice to be given for two consecutive weeks in some newspaper published in the county wherein such improvement is located, if such there be, and such additional publication elsewhere as they may deem expedient, of the time and place of letting the work of construction of said improvement, and in such notice they shall specify the approximate amount of work to be done and the time fixed for the completion thereof; and on the date appointed for the letting, they, together with the superintendent of construction, shall convene and let to the lowest responsible bidder, either as a whole or in sections, as they may deem most advantageous for the district, the proposed work. No bid shall be entertained that exceeds the estimated cost, except for good and satisfactory reasons it shall be shown that the original estimate was erroneous. They shall have the right to reject all bids and advertise again the work, if in their judgment the interest of the district will be subserved by doing so. The successful bidder shall be required to enter into a contract with the board of drainage commissioners and to execute a bond for the faithful performance of such contract, with sufficient sureties, in favor of the board of drainage commissioners for the use and benefit of the levee or drainage district, in an amount equal to twenty-five per centum of the estimated cost of the work awarded to him.

c. 442 (21), 1909.

In canvassing bids and letting the contract, the superintendent of construction shall act only in an advisory capacity to the board of drainage commissioners. The contract shall be based on the plans and specifications submitted by the viewers in their final report as confirmed by the court, the original of which shall re-

Superintendent
of construction.
Bond of super-
intendent.

Advertisement
for letting of
contracts.

Work let to
lowest responsible
bidder.

Bids exceeding
estimate not
considered.

Right to reject
all bids.

Successful bidder
to enter into
contract and give
bond.

Superintendent to
act in advisory
capacity.

main on file in the office of the clerk of the Superior Court and shall be open to the inspection of all prospective bidders. All bids shall be sealed and shall not be opened except under the authority of the board of drainage commissioners and on the day theretofore appointed for opening the bids. The drainage commissioners shall have power to correct errors and modify the details of the report of the engineer and viewers, if in their judgment they can increase the efficiency of the drainage plan and afford better drainage to the lands in the district without increasing the estimated cost submitted by the engineer and viewers and confirmed by the court.

Drainage commissioners have power to correct errors.

c. 67 (4), 1911.

SEC. 22. *Payment for work done.*

The superintendent in charge of construction shall make monthly estimates of the amount of work done, and furnish one copy to the contractor and file the other with the secretary of the board of drainage commissioners; and the commissioners shall, within five days after the filing of such estimate, meet and direct the secretary to draw a warrant in favor of such contractor for ninety per centum of the work done, according to the specifications and contract; and upon the presentation of such warrant, properly signed by the chairman and secretary, to the treasurer of the drainage fund, he shall pay the amount due thereon. When the work is fully completed and accepted by the superintendent he shall make an estimate for the whole amount due, including the amounts withheld on the previous monthly estimates, which shall be paid from the drainage fund as before provided.

Superintendent to make and file monthly estimates.

Warrants for payments.

Payment of warrants.

Payment in full on completion of work.

c. 442 (22), 1909.

SEC. 23. *Failure of contractor—Reletting.*

If any contractor to whom said work shall have been let shall fail to perform the same according to the terms specified in his contract, action may be had in behalf of the board of drainage commissioners against such contractor and his bond in the Superior Court for damages sustained by the levee or drainage district, and recovery made against such contractor and his sureties. In such an event the work shall be advertised and relet in the same manner as the original letting.

Suit on bond of contractor.

Work advertised and relet.

c. 442 (23), 1909; c. 67 (5), 1911.

SEC. 24. *Right of contractor.*

In the construction of the work the contractor shall have the right to enter upon the lands necessary for this purpose and the right to remove private or public bridges or fences and to cross private lands in going to or from the work. In case the right of way of the improvement is through timber the owner thereof shall have the right to remove it, if he so desires, before the work of construction begins, and in case it is not removed by the landowner it shall become the property of the contractor and may be removed by him.

Right of contractor to enter on lands.

Removal and ownership of timber.

c. 442 (24), 1909.

SEC. 25. Highways affected.

Where any public ditch, drain or water course established under the provisions of this act crosses a public highway the actual cost of constructing the same across the highway or removing old bridges or building new ones shall be paid for from the fund of the drainage district. Wherever any highway within the levee or drainage district shall be beneficially affected by the construction of any improvement or improvements in such district it shall be the duty of the viewers appointed to classify the land to give in their report the amount of benefit to such highway, and notice shall be given by the clerk of the Superior Court to the clerk of the board of county commissioners in the county where the road is located of the amount of such assessment, and the county commissioners shall have the right to appear before the court and file its objections, the same as any landowner.

Cost of drains across highways.

Highways benefited to be included in report.

Notice of assessment on highways.

c. 442 (25), 1909.

When it shall become necessary for the drainage commissioners to repair any bridge or construct a new bridge across a highway by reason of enlarging any water course, or of excavating any canal intersecting such highway, the said bridge shall thereafter be maintained by and at the expense of the board of commissioners of such county, or by such other official board or authority as by law shall be required to maintain such highway so intersected.

Repair or construct bridge.

Maintained at expense of county.

c. 67 (6), 1911.

SEC. 26. Railroad—Damage—Benefit.

Whenever the engineer and the viewers in charge shall make a survey for the purpose of locating a public levee or drainage district or changing a natural water course, and the same would cross the right of way of any railroad company, it shall be the duty of the owner in charge of the work to notify the railroad company, by serving written notice upon the agent of such company or its lessee or receiver, that they will meet the company at the place where the proposed ditch, drain or water course crosses the right of way of such company, said notice fixing the time of such meeting, which shall not be less than ten days after the service of the same, for the purpose of conferring with said railroad company with relation to the place where and the manner in which such improvement shall cross such right of way. When the time shall arrive fixed for such conference, unless for good cause more time is agreed upon, it shall be the duty of the viewers in charge and the railroad company to agree, if possible, upon the place where and the manner and method in which such improvement shall cross such right of way. If the viewers in charge and the railroad company cannot agree, or if the railroad company shall fail, neglect or refuse to confer with the viewers, they shall determine the place and manner of crossing the right of way of said railroad company, and shall specify the number and size of openings required, and the damages, if any, to said rail-

Procedure to determine place and manner of crossing right of way of railroad companies.

Agreement.

Procedure in case of disagreement.

Facts not considered as damages.

Benefits to be assessed.

Assessment at a fixed sum.

road company, and so specify in their report. The fact that the railroad company is required by the construction of the improvement to build a new bridge or culvert or to enlarge or strengthen an old one shall not be considered as damages to said railroad company. The engineer and viewers shall also assess the benefits that will accrue to the right of way, roadbed and other property of said company by affording better drainage or a better outlet for drainage, but no benefits shall be assessed because of the increase in business that may come to said road because of the construction of the improvement. The benefits shall be assessed at a fixed sum, determined solely by the physical benefit that its property will receive by the construction of said improvement, and it shall be reported by the viewers as a special assessment, due personally from the railroad company as a special assessment; it may be collected in the manner of an ordinary debt in any court having jurisdiction.

c. 442 (26), 1909.

Sec. 27. *Notice to railroad.*

Notice of final hearing to be served on railroad company.

The clerk of the Superior Court shall have notice served upon the railroad company of the time and place of the meeting to hear and determine the final report of the engineer and viewers, and the said railroad company shall have the right to file objections to said report and to appeal from the findings of the board of commissioners in the same manner as any landowner. But such an appeal shall not delay or defeat the construction of the improvement.

c. 442 (27), 1909.

Sec. 28. *Manner of crossing right of way—Penalty for delay—Cost.*

Notice to railroad company of time of work.

Time to be agreed on.

Railroad company to remove obstructions.

After the contract is let and the actual construction is commenced, if the work is being done with a floating dredge, the superintendent in charge of construction shall notify the railroad company of the probable time at which the contractor will be ready to enter upon the right of way of said road and construct the work thereon. It shall be the duty of said railroad to send a representative to view the ground with the superintendent of construction and arrange the exact time at which such work can be most conveniently done. At the time agreed upon the said railroad company shall remove its rails, ties, stringers and such other obstructions as may be necessary to permit the dredge to excavate the channel across its right of way. The work shall be so planned and conducted as to interfere in the least possible manner with the business of said railroad. *If the superintendent of construction and the railroad company shall not be able to agree as to the exact time at which such work can be done, including the time of beginning and the time to be consumed in such work, either party may give written notice thereof to the chairman of the Corporation Commission of the State, and thereupon the said Corporation Commission shall cause an investigation to be made, and, after hearing both parties, shall fix the time of beginning such work and the time to be consumed in such work of construction,*

Corporation commission shall fix time in case of disagreement.

and the final determination of the Corporation Commission thereon shall be binding upon the superintendent of construction representing the district and the railroad company, and the work shall be done in such time as may be fixed by the said Corporation Commission. In case the railroad company refuses and fails to remove its track and allow the dredge to construct the work on its right of way it shall be held as delaying the construction of the improvement, and such company shall be liable to a penalty of twenty-five dollars per day for each day of delay, to be collected by the board of drainage commissioners for the benefit of the drainage district as in the case of other penalties. Such a fine may be collected in any court having jurisdiction and shall inure to the benefit of the drainage district. Within thirty days after the work is completed, an itemized bill for the actual expenses incurred by the railroad company for opening its tracks shall be made and presented to the superintendent of construction of the drainage improvement. Such bill, however, shall not include the cost of putting in a new bridge or strengthening or enlarging an old one. The superintendent of construction shall audit this bill and, if found correct, approve the same and file it with the secretary of the board of drainage commissioners. The commissioners shall deduct from this bill the cost of the excavation done by the dredge on the right of way of said railroad company at the contract price, and pay the difference, if any, to said railroad company.

Refusal to remove obstructions and permit work a delay of construction. Penalty.

Railroad company to present itemized bill.

Superintendent to audit bill.

Cost of excavation deducted and bill paid.

c. 442 (28), 1909; c. 67 (7), 1911.

SEC. 29. Control and repairs.

Whenever any improvement constructed under this act is completed it shall be under the control and supervision of the board of drainage commissioners. It shall be the duty of the said board to keep the levee, ditch, drain or water course in good repair, and for this purpose they may levy an assessment on the lands benefited by the construction of such improvement in the same manner and in the same proportion as the original assessments were made, and the fund that is collected shall be used for repairing and maintaining the ditch, drain or water course in perfect order: *Provided, however,* that if any repairs are made necessary by the act or negligence of the owner of any land through which such improvement is constructed or by the act or negligence of his agent or employee, or if the same is caused by the cattle, hogs or other stock of said owner, employee or agent, then the cost thereof shall be assessed and levied against the lands of said owner alone, to be collected by proper suit instituted by the drainage commissioners. It shall be unlawful for any person to injure or damage or obstruct or build any bridge, fence or flood gate in such a way as to injure or damage any levee, ditch, drain, or water course constructed or improved under the provisions of this act, and any person causing such injury shall be guilty of a misdemeanor, and upon conviction thereof may be fined in any sum not exceeding twice the damage or injury done or caused.

Completed work to be under control of drainage commissioners. Duty to maintain work.

Assessment for maintenance and repairs.

Proviso: repairs made necessary by negligence.

Injury to works a misdemeanor.

Punishment.

c. 442 (29), 1909.

SEC. 30. Outlet for lateral drains.

Rights of owners
of assessed lands.

Procedure for
condemnation of
access to drain.

The owner of any land that has been assessed for the cost of the construction of any ditch, drain or water course, as herein provided, shall have the right to use the ditch, drain or water course as an outlet for lateral drains from said land; and if said land is separated from the ditch, drain or water course by the land of another or others, and the owner thereof shall be unable to agree with said other or others as to the terms and conditions on which he may enter their lands and construct said drain or ditch, he may file his ancillary petition in such pending proceeding to the court, and the procedure shall be as now provided by law. When the ditch is constructed it shall become a part of the drainage system and shall be under the control of the board of drainage commissioners and be kept in repair by them as herein provided.

c. 442 (30), 1909.

SEC. 31. Assessment-tax roll and amount to be assessed.

Ascertainment of
amount to be
assessed.

*After the classification of lands and the ratio of assessments of the different classes to be made thereon has been confirmed by the court, the board of drainage commissioners shall ascertain the total cost of the improvement, including damages awarded to be paid to owners of land, all costs and incidental expenses, and also including an amount sufficient to pay the necessary expenses of maintaining the improvement for a period of three years after the completion of the work of construction, after deducting therefrom any special assessments made against any railroad or highway, and, thereupon, the board of drainage commissioners, under the hand of the chairman and secretary of the board, shall certify to the clerk of the Superior Court the said total cost, ascertained as aforesaid; and the said certificate shall be forthwith recorded in the drainage record and open to inspection of any landowner in the district.**

c. 67 (S), 1911.

*Section 31 of chapter 442 of 1909 was amended by striking out the section and inserting the above in lieu thereof. The following is a copy of the original section:

SEC. 31. Assessment-tax roll.

After the classification of the land and the ratio of assessment of the different classes to be made thereon has been confirmed by the court, the drainage commissioners shall prepare an assessment roll or drainage-tax duplicate, giving a description of all the land in said drainage district, the name of the owner, so far as can be ascertained from the public records, and the amount of assessment against each of the several tracts of land. In preparing this assessment roll the board shall ascertain the total cost of the improvement, including the damages awarded and to be paid to the owners of land, and all incidental expenses, and deduct therefrom any special assessment made against any railroad or highway, and the remainder shall be the amount to be borne and paid by the lands benefited. This amount shall be assessed against the several tracts of land according to the benefit received, as shown by the classification and ratio of assessment made by the viewers and confirmed by the board of drainage commissioners. This drainage-tax roll shall be made in duplicate, signed by the chairman and secretary, and one copy filed with the drainage record and the other delivered to the sheriff or other county tax collector. There shall be appended an order to collect the said assessments, and the same shall have the force and effect of a judgment as in the case of State and county taxes.

SEC. 31. Continued.

The board of drainage commissioners shall immediately prepare, in duplicate, the assessment rolls, or drainage tax lists, giving thereon the names of the owners of land in the district, so far as can be ascertained from the public records, a brief description of the several tracts of land assessed, and the amount of the assessment against each tract of land. The first of these assessment rolls shall provide assessments sufficient for the payment of interest on the bond issue to accrue the third year after their issue and the instalment of principal to fall due at the expiration of the third year after the date of issue, together with such amounts as shall have to be paid for collection and handling of the same. The second assessment roll shall make like provision for the fourth year; the third for the fifth year; the fourth for the sixth year; the fifth for the seventh year; the sixth for the eighth year; the seventh for the ninth year; the eighth for the tenth year; the ninth for the eleventh year; the tenth for the twelfth year. Each of said assessment rolls shall specify the time when collectible and be numbered in their order, and the amounts assessed against the several tracts of land shall be in accordance with the benefits received, as shown by the classification and ratio of assessments made by the viewers. These assessment rolls shall be signed by the chairman of the board of drainage commissioners and by the secretary of the board. One copy of each of the said assessment rolls shall be filed with the drainage record and one copy shall be delivered to the sheriff, or other county tax collector, after the clerk of the Superior Court has appended thereto an order directing the collection of said assessments, and the said assessments shall thereupon have the force and effect of a judgment as in the case of State and county taxes. These assessments shall constitute a first and paramount lien, second only to State and county taxes, upon the lands assessed for the payment of said bonds and interest thereon as they become due, and shall be collected in the same manner by the same officers as the State and county taxes are collected. The said assessments shall be due and payable on the first Monday in September each year, and if the same shall not be paid in full by the thirty-first day of December following, it shall be the duty of the sheriff or tax collector to sell the land or lands so delinquent. The sale of lands for failure to pay such assessments shall be made at the courthouse door of the county in which the lands are situated, between the hours of ten o'clock in the forenoon and four o'clock in the afternoon of the first Monday in February of each year; and if for any necessary cause the sale cannot be made on that date, the sale may be continued from day to day for not exceeding four days, or the lands may be re-advertised and sold on the first Monday in March succeeding, during the same hours, without any order therefor. In all other respects, except as to time of sale of lands, the existing law as to the collection of State and county taxes shall have application to the collection of drainage assessments under this act. It shall be the duty

Drainage commissioners to prepare assessment-tax rolls. Drainage-tax roll in duplicate.

First assessment roll.

Second assessment roll.

Time when collectible.

Rolls, how signed.

Order to collect assessment.

Lien on lands.

Assessments, when due.

Sale of land for nonpayment of assessment.

How advertised.

Duty of sheriff.

Duty of county treasurer.

of the sheriff or tax collector to pay over to the county treasurer promptly the moneys so collected by him upon said tax assessments, to the end that the said treasurer may have funds in hand to meet the payments of interest and principal due upon the outstanding bonds as they mature. It shall be the duty of the county treasurer, and without any previous order from the board of drainage commissioners, to provide and pay the instalments of interest at the time and place as evidenced by the coupons attached to said bonds, and also to pay the annual instalments of the principal due on said bonds at the time and place as evidenced by the said bonds, and the said county treasurer shall be guilty of a misdemeanor and subject upon conviction to a fine and imprisonment, in the discretion of the court, if he shall wilfully fail to make prompt payments of the said interest and principal upon said bonds, and shall likewise be liable in a civil action for all damages which may accrue either to the board of drainage commissioners or the holder of said bonds, to either or both of which a right of action is hereby given.

c. 67 (12), 1911.

SEC. 32. *Time of payment.**

Assessment payable in one instalment.

If the total cost of the improvement is less than an average of twenty-five cents per acre on all the land in the district, the board of drainage commissioners shall forthwith assess the lands in the district therefor, in accordance with their classification, and said assessment shall be collected in one instalment, by the same officer and in the same manner as State and county taxes are collected, and payable at the same time. In case the total cost exceeds an average of twenty-five cents per acre on all lands in the district, the board of drainage commissioners shall give notice for three weeks by publication in some newspaper published in a county in which the district, or some part thereof, is situated, if there be any such newspaper, and also by posting a written or printed notice at the door of the courthouse and at five conspicuous places in the district, reciting that they propose to issue bonds for the payment of the total cost of the improvement, giving the amount

Advertisement of purpose to issue drainage bonds.

*Section 32 of chapter 442 of 1909 was amended by striking out the section and adding the above. Original section is given below:

SEC. 32. *Time of payment.*

If the total cost of the work is less than an average of twenty-five cents per acre on all the land in the district the assessment made against the several tracts shall be collected in one instalment, by the same officer and in the same manner as State and county taxes are collected, and payable at the same time. In case the total assessment exceeds the average of twenty-five cents per acre on all the lands in the district the said board of drainage commissioners may give notice of three weeks by publication in some newspaper of general circulation in the district, if there be one, and also by posting a written or printed notice at the door of the courthouse and at five conspicuous places in the drainage district, that they propose to issue bonds for the construction of said improvement, giving the amount of bonds to be issued, the rate of interest they are to bear and the time when payable. Any landowner having lands assessed in the district and not wanting to pay interest on the bonds may, within thirty days after the publication of said notice, pay the county treasurer the full amount of his assessment and have his land released therefrom.

of bonds to be issued, the rate of interest that they are to bear and the time when payable. Any landowner in the district not wanting to pay interest on the bonds may, within fifteen days after the publication of said notice, pay to the county treasurer the full amount for which his land is liable, to be ascertained from the classification sheet and the certificate of the board showing the total cost of the improvement, and have his lands released from liability to be assessed for the said improvement; but such land shall continue liable for any future assessment for maintenance or for any increased assessment authorized under the law.

Land released on payment of assessment.

Liability for future assessments.

c. 67 (9), 1911.

SEC. 33. Defense—Waiver.*

Each and every person owning land in the district who shall fail to pay to the county treasurer the full amount for which his land is liable, as aforesaid, within the time above specified, shall be deemed as consenting to the issuance of drainage bonds, and in consideration of the right to pay his proportion in instalments he hereby waives his right of defense to the payment of any assessments which may be levied for the payment of bonds, because of any irregularity, illegality, or defect in the proceedings prior to this time, except in case of an appeal, as heretofore provided, which is not affected by this waiver. The term "person" as used in this act includes any firm, company, or corporation.

Failure to pay assessment.

Waiver of right of defense.

c. 67 (10), 1911.

SEC. 34. Bond issue.

At the expiration of fifteen days after publication of notice of bond issue, the board of drainage commissioners may issue bonds of the drainage district for an amount equal to the total cost of the improvement, less such amounts as shall have been paid in cash to the county treasurer, plus an amount sufficient to pay interest on the bond issue for the three years next following the date of issue. These bonds shall bear six per cent interest per annum, payable semi-annually, and shall be paid in ten equal instalments. The first instalment of principal shall mature at the expiration of three years from the date of issue, and one instalment for each succeeding year for nine additional years. The commissioners may sell these bonds at not less than par and devote the proceeds to the payment for the work as it progresses and to the payment of the

Bond issue authorized. Amount.

Interest.

Maturity.

First instalment.

Sale of bonds.

*Section 33 of chapter 442 of 1909, given below, was amended by striking out the section and adding in lieu thereof section 33, above.

SEC. 33. Defense—Waiver.

Each and every person owning land in the district which is assessed for the construction of an improvement, who shall neglect or fail to pay the full amount of his assessment to the county treasurer within the time specified, shall be deemed as consenting to the issuing of said drainage bonds, and in consideration of the right to pay his assessment in instalments he hereby waives his right to any defense against the collection of said assessment because of any irregularity, illegality, or defect in the proceedings prior to this time, except in the case of an appeal, as heretofore provided, which is not affected by this waiver. The term "person," as used in this act, includes any firm, company, or corporation.

Proceeds of bonds,
how expended.

Mandamus for
levy of assess-
ment to meet
instalments of
bonds.

Suits on official
bonds.

interest on said bonds for the three* years next following the date of issue and to the payment of the other expenses of the district provided for in this act. The proceeds from such bonds shall be for the exclusive use of the levee or drainage district specified on their face, and shall be numbered by the board of drainage commissioners and recorded in the drainage record, which record shall set out specifically the lands embraced in the district on which the tax has not been paid in full, which land is to be assessed as hereafter provided. If any instalment of principal or interest represented by the said bond shall not be paid at the time and in the manner when the same shall become due and payable, and such default shall continue for a period of six months, the holder or holders of such bond or bonds upon which default has been made may have a right of action against said drainage district or the board of drainage commissioners of said district, wherein the court may issue a writ of mandamus against the said drainage district, its officers, including the tax collector and treasurer, directing the levying of a tax or special assessment as herein provided, and the collection of same, in such sum as may be necessary to meet any unpaid instalments of principal and interest and cost of action; and such other remedies are hereby vested in the holder or holders of such bond or bonds in default as may be authorized by law; and the right of action is hereby vested in the holder or holders of such bond upon which default has been made, authorizing them to institute suit against any officer on his official bond for failure to perform any duty imposed by the provisions of this act. The official bonds of the tax collector and county treasurer shall be liable for the faithful performance of the duties herein assigned them. Such bonds may be increased by the board of county commissioners.†

c. 67 (11), 1911.

*This originally read "two," but the following act was passed, changing it to "three":

AN ACT SUPPLEMENTAL TO H. B. 1800 AND S. B. 780 OF THE
GENERAL ASSEMBLY OF 1911.

The General Assembly of North Carolina do enact:

SECTION 1. That House Bill one thousand eight hundred and Senate Bill seven hundred and eighty-nine of the General Assembly of one thousand nine hundred and eleven, which was ratified the third day of March, one thousand nine hundred and eleven, be amended by striking out the word "two" before the word years, in line six of page ten of said bill, and substituting therefor the word "three."

SEC. 2. That this act shall be in force from and after its ratification.

Ratified this the 8th day of March, A. D. 1911.

†Section 34 of chapter 442 of 1909 was amended by striking out the section and adding in lieu thereof the above. The original section was as follows:

SEC. 34. *Bond issue.*

At the expiration of the thirty days after the publication the board of drainage commissioners may issue bonds for the full amount of the assessment not paid in to the county treasurer, together with the interest thereon, costs of collection or other incidental expenses. These bonds shall bear six per cent interest per annum, payable annually, and shall be paid in ten equal annual instalments. The first instalment of the principal shall mature at the expiration of three years from the date of issue, and one instalment each succeeding year for nine additional years. The commissioners may sell these bonds at not less than par and devote the proceeds to the payment of the work as it progresses. In no case shall bonds be issued

SEC. 34. *Continued.*

That the bonds and coupons issued under and by authority of Bonds exempt
from taxation.
*section thirty-four of chapter four hundred and forty-two of the Public Laws of one thousand nine hundred and nine shall during the years one thousand nine hundred and eleven to one thousand nine hundred and twenty-five exclusive be exempt from all county or municipal taxation or assessment, direct or indirect, general or special, whether imposed for purposes of general revenue or otherwise, and the interest thereon shall not be subject to taxation as for income, nor shall said bonds and coupons be subject to taxation when constituting a part of the surplus of any bank, trust company, or other corporation, but when constituting a part of such surplus shall be deducted from the total assets in order to ascertain the taxable value of such shares.**

c. 177 (1), 1911.

SEC. 34½. *Fees allowed sheriff and treasurer.*

That the fee allowed the sheriff or other county tax collector Sheriff's fee.
for collecting the drainage tax as prescribed in section thirty-four of chapter four hundred and forty-two of the Public Laws of one thousand nine hundred and nine shall be two per cent of the amount collected, and the fee allowed the county treasurer for dis- Treasurer's fee.
bursing the revenue obtained from the sale of the drainage bonds shall be one per cent of the amount disbursed: Provided, no fee shall be allowed the sheriff or other county tax collector or county treasurer for collecting or receiving the revenue obtained from the sale of the bonds provided for in section thirty-four of chapter four hundred and forty-two of the Public Laws of one thousand nine hundred and nine, nor for disbursing the revenue raised for paying

until the tax levy has been made to meet them as they come due. The bonds issued shall be for the exclusive use of the levee or drainage district specified on their face, and should be numbered by the board of drainage commissioners and recorded in the drainage record, which record shall set out specifically the lands embraced in the district on which the tax has not been paid in full, and which land is assessed for the payment of the bonds issued and the interest thereon. This assessment shall constitute the first and paramount lien, second only to State and county taxes, upon the lands assessed for the payment of said bonds and the interest thereon as they become due, and shall be collected in the same manner by the same officers as the State and county taxes are collected. If any instalment of principal or interest represented by the said bond shall not be paid at the time and in the manner when the same shall become due and payable, and such default shall continue for a period of six months, the holder or holders of such bond or bonds upon which default has been made may have a right of action against said drainage district or the board of drainage commissioners of said district, wherein the court may issue a writ of *mandamus* against the said drainage district, its officers, including the tax collector and treasurer, directing the levying of a tax or special assessment as herein provided, and the collection of the same, in such sum as may be necessary to meet any unpaid instalments of principal and interest and cost of action; and such other remedies are hereby vested in the holder or holders of such bond or bonds in default as may be authorized by law; and the right of action is hereby vested in the holder or holders of such bond upon which default has been made authorizing them to institute suit against any officer on his official bond for failure to perform any duty imposed by the provisions of this act. The official bonds of the tax collector and county treasurer shall be liable for the faithful performance of the duties herein assigned them. Such bonds may be increased by the board of county commissioners.

*This part of the act was ratified on the 8th of March, 1911.

When fees not allowed.

off the said bonds: Provided further, that in those counties where the sheriff or tax collector and treasurer are on a salary basis, no fees whatever shall be allowed for collecting or disbursing the funds of the drainage district.

c. 67 (13), 1911.

SEC. 35. *Reliev.*

Power to change or modify assessment.

Where the court has confirmed an assessment for the construction of any public levee, ditch or drain, and such assessment has been modified by the court of superior jurisdiction, but for some unforeseen cause it cannot be collected, the board of drainage commissioners shall have power to change or modify the assessment as originally confirmed to conform to the judgment of the Superior Court and to cover any deficit that may have been caused by the order of said court or unforeseen occurrence. The said reliev shall be made for the additional sum required, in the same ratio on the lands benefited as the original assessment was made.

c. 442 (35), 1909.

Failure to pay annual assessment.

If any person, or any number of persons, claiming to have title to any tract or tracts of land subject to assessment or drainage tax shall fail to pay any annual assessment levied against such lands, and the sheriff or tax collector shall be compelled to sell such lands under the law for the purpose of making such collection, the net proceeds of such sale shall be paid to the county treasurer, to be held by him and disbursed for the purpose of paying the current assessment and future annual assessments so far as the said proceeds may be sufficient. When the fund in the custody of the treasurer shall be exhausted in the payment of annual assessments against such lands, or there shall not be a sufficient sum to pay the next annual assessment, the county treasurer shall immediately give written notice to that effect to the chairman of the board of drainage commissioners of the district, and also to the clerk of the Superior Court, whereupon the board of drainage commissioners shall institute an investigation of said tract or tracts of land to determine its market value, and if they shall find that its market value is not equal to all the future annual assessments to cover its share of instalments of principal and interest on the outstanding bonds, they shall proceed, with the approval of the clerk of the Superior Court, to make new reassessment rolls on all the remaining lands in the district and increase the sum in sufficient sums to equal the deficit thereby created, and such new assessment rolls shall constitute the future assessment rolls until changed according to law, and shall be certified to the tax collector as herein provided in lieu of the former assessment rolls. However, the said tract or tracts of land which have been so sold by the tax collector shall continue on the assessment roll in the name of the new owner, but reassessed upon the new basis, and the drainage tax collected at the same time and in the same manner as other lands as long as said lands may have sufficient market value

Sale of land.

New assessment roll.

Lands sold for taxes remain on assessment roll.

out of which to collect the annual drainage tax, and when such lands shall cease to have such value, or shall be abandoned by the person claiming title thereto, the drainage commissioners may omit the same from the assessment roll with the approval of the clerk of the Superior Court; but the said lands may in the same manner at any time in the future be restored to the assessment rolls. If the funds in the hands of the county treasurer at any time, arising under this section or in any other manner, shall be greater than is necessary to pay the annual instalments of principal and interest, or the annual cost of maintenance of the drainage works, or both, such surplus shall be held by the county treasurer for future disbursement for other purposes as herein provided or subject to the order of the board of drainage commissioners. If there shall be any impairment or destruction of the drainage works by any unforeseen cause or occurrence not anticipated, during the period of construction by the contractor, the said contractor shall nevertheless repair and complete the said works according to the contract and specifications, and shall be liable therefor and also his sureties on his bond; but if said contractor shall make default and if there shall be a failure to collect all resulting damages from such contractor and the sureties upon his bond, and it shall thereby be necessary to raise a greater sum of money to complete the drainage works in accordance with the plans, or if for any other unavoidable cause it shall be necessary to raise a greater sum to complete such drainage works, the board of drainage commissioners, having first obtained the approval of the clerk of the Superior Court, shall prepare new assessment rolls upon all the lands in the district upon the original basis of classification of benefits, and increase the same in sufficient sums to equal the deficit thereby created, and the same shall constitute the new assessment rolls until changed according to law, and shall be certified to the tax collector as herein provided. If for any of the causes hereinbefore recited in this section or for any other cause, a sum of money greater than the proceeds of sale of the drainage bonds shall become necessary to complete said drainage system, and the board of drainage commissioners shall determine that the amount to be raised is greater than can be realized from the collection of one annual assessment upon the lands in the district without imposing an undue burden upon said lands, or if it is advisable or necessary to raise the money more expeditiously, then and under such conditions additional bonds may be issued in such aggregate sum as may be necessary. The proceedings for the issue of such additional bonds shall be substantially as follows: The board of drainage commissioners shall file their petition with the clerk of the Superior Court, setting forth all the facts which require the expenditure of more money and the issue of additional bonds to complete the drainage system, which shall be accompanied by the recommendation of the drainage engineer, who was one of the original viewers, or some other expert drainage engineer selected by the

Funds greater than necessary for work; how surplus shall be used.

Default of contractor.

Necessity of raising greater sum than first obtained.

Additional issue of bonds.

Show cause why additional bonds should not be issued.

Order of court authorizing bond issue.

Appeal.

Not to exceed twenty-five per cent.

Pay of engineer.

Viewers, other than engineer.

Rodmen and other laborers. Fees and costs as prescribed by law.

drainage commissioners; whereupon the court shall issue a notice to all the owners of land within the district, reciting the substance of the petition and directing each to appear before the court on a day certain, not less than twenty days after the service upon all the parties, and to show cause, if any they have, why the additional bonds should not be authorized, which notice shall be served personally on each such landowner by reading the same, and by leaving a copy, and, if the same cannot be personally served, then it shall be served in the manner authorized by law. Any landowner may file an answer denying any material allegation in the petition or setting forth any valid objection to same before the return day thereof. Upon the day when said notice is returnable, or on such day as to which the same may have been continued, the court shall proceed to hear the petition and answers. If the court shall find that the allegations of the petition are true and that the issue of additional bonds is advisable or necessary the court shall make an appropriate order authorizing and directing the issue of such additional bonds, fixing the amount of such issue, the date of same, the time when the interest and principal shall be payable, and all other matters necessary and appropriate in the premises. Any landowner may appeal from the order of the clerk of the Superior Court, and on such appeal only the issues raised in the answer shall be considered, and such appeal and the further procedure thereon shall be as prescribed in special proceedings, except as modified by the act of which this is amendatory. After the court shall have ordered the additional issue of bonds, the further procedure as to the assessment rolls, the levying and collecting of the drainage taxes, the disbursement of the revenue therefrom for the payment of said bonds and interest thereon, and all further procedure shall be the same as required by chapter four hundred and forty-two of the Public Laws of one thousand nine hundred and nine, and amendments thereto, for the establishment of drainage districts. The additional bonds issued shall not exceed twenty-five per cent of the total amount originally issued. The additional issue of bonds shall bear six per cent interest per annum and may be made payable in ten annual instalments, or lesser number of annual instalments as nearly equal as may be, as recommended by the board of drainage commissioners and approved by the court.

c. 67 (15), 1911.

SEC. 36. Fees and expenses.

Any engineer employed under the provisions of this act shall receive such compensation per diem for his services as shall be fixed and determined by the drainage commissioners. The viewers, other than the engineer, shall receive three dollars per day; the rodmen, axmen, chainmen and other laborers shall receive not to exceed two dollars per day each. All other fees and costs incurred under the provisions of this act shall be the same as provided by law for like services in other cases. Said costs and expenses shall

be paid, by the order of the court, out of the drainage fund provided for that purpose, and the board of drainage commissioners shall issue warrants therefor when funds shall be in the hands of the treasurer.

c. 442 (36), 1909.

SEC. 37. *Defects in proceedings.*

The provisions of this act shall be liberally construed to promote the leveeing, ditching, draining and reclamation of wet and overflowed lands. The collection of the assessment shall not be defeated, where the proper notices have been given, by reason of any defect in the proceedings occurring prior to the order of the court confirming the final report of the viewers; but such order or orders shall be conclusive and final that all prior proceedings were regular and according to law, unless they were appealed from. If on appeal the court shall deem it just and proper to release any person or to modify his assessment or liability, it shall in no manner affect the rights and legality of any person other than the appellant, and the failure to appeal from the order of the court within the time specified shall be a waiver of any illegality in the proceedings, and the remedies provided for in this act shall exclude all other remedies.

Act to be liberally construed.
Order confirming final report conclusive.
Modification on appeal to affect appellant only.
Failure to appeal a waiver.

c. 442 (37), 1909.

SEC. 38. Proceedings under this act may be *ex parte* or adversary. Any engineer, viewer, superintendent of construction or other person appointed under this act may be removed by the court, upon petition, for corruption, negligence of duties or other good and satisfactory cause shown.

Proceedings ex parte.
Removal of officers or employees for cause.

c. 442 (38), 1909.

SEC. 38½. This act shall not repeal or change any local drainage laws already enacted or to be enacted by the General Assembly of one thousand nine hundred and nine.

Local drainage laws not affected.

c. 442 (38½), 1909.

SEC. 39. All laws in conflict with this act are hereby repealed: *Provided*, that proceedings now pending by virtue of any statute now or heretofore in force in this State in any county shall not be affected by this act, but that such proceedings may be continued in accordance with such statute or in accordance with the provisions of this act.

Repealing clause.
Proviso: proceedings pending not affected.

c. 442 (39), 1909.

SEC. 40. This act shall be in effect from and after its ratification.

Ratified this the 5th day of March, A. D. 1909.*

c. 442 (40), 1909.

SEC. 41. *That this act shall apply to all drainage proceedings which may be pending at the date of its ratification and to all drainage districts heretofore established for which the bonds of said district have not been issued at the date of its ratification, so*

Application of act.

*This refers to all those portions of the acts given above that are not in italics.

Drainage proceedings instituted but not completed.

Proviso: vested rights not impaired.

far as the same may be applicable. Such of the provisions of this act as refer to parts or stages of drainage proceedings which have been instituted but not completed shall apply to the parts or stages of such proceedings which may occur subsequent to the ratification of this act, including duties imposed upon the board of drainage commissioners, the court, the sheriff or tax collector and county treasurer and others after the confirmation of the final report of the viewers: Provided the same are not inconsistent with the preceding acts and decrees in any pending proceeding; and Provided further, that no vested right theretofore acquired shall be impaired. Subject to the foregoing provisions of this section, this act shall be in effect from and after its ratification.

*Ratified this the 3d day of March, A. D. 1911.**

c. 67 (16), 1911.

*This refers to all the acts given above in italics except as otherwise mentioned.

**DECISION BY SUPREME COURT OF NORTH CAROLINA
REGARDING THE VALIDITY OF NORTH CARO-
LINA DRAINAGE BONDS.**

In order to determine the validity of the bonds issued by authority of the North Carolina Drainage Law, a test case relating to the bonds of the Moyock Drainage District, No. 1, was tried. This case was heard by consent of parties before Judge G. W. Ward at chambers in Elizabeth City, on May 12, 1910. The decision of the Superior Court was that the bonds were valid. The case was taken to the Supreme Court of North Carolina and was argued at the February Term, 1910, the case being known as *Sanderlin v. Luken et al.*, reported in 152 N. C., 738. The judgment of the Superior Court was affirmed, the decision being written by Justice Hoke. There is given below a copy of this decision.

**DECISION BY SUPREME COURT OF NORTH CAROLINA REGARDING
VALIDITY OF NORTH CAROLINA DRAINAGE BONDS.**

CIVIL ACTION, heard by consent of parties before *Ward, J.*, at chambers, in Elizabeth City, on May 12, 1910.

The facts relevant to the controversy, and the questions presented for decision, are very well stated in the brief of counsel for appellants, as follows:

"This is a case involving the constitutionality of the act of the General Assembly of North Carolina of 1909, chapter 442, authorizing the establishment of levee or drainage districts; of the validity of bonds which the commissioners of a drainage district, purporting to have been established under the act, have contracted to issue; and also of the action of the commissioners in letting the contract for the construction of the work to one who was not the lowest bidder, in view of the provision of the statute requiring the contract to be let to the 'lowest responsible bidder.'

"Under the statute, a petition for the establishment of a drainage district in Currituck County was presented to the clerk of the Superior Court, and after proceedings duly taken was declared to be established as the Moyock District, No. 1. The plaintiff herein is a citizen, taxpayer, and landowner within the boundaries of the district, and his lands have been assessed, for the costs of the improvements to be made, under the classification of the lands embraced in the district according to the provisions of the statutes. The plaintiff has brought this suit to restrain the commissioners of the drainage district from issuing bonds contracted for to defray the costs and expenses of the proposed improvements.

"Upon the case being brought to a hearing, it was adjudged by the court below that the act of 1909, chapter 442, is valid and that the proceedings of the commissioners were regular, and that the plaintiff was not entitled to the injunction prayed for. An appeal was taken and has been duly perfected.

"The following propositions, involving the constitutionality of the statute and the validity of the bonds, and also the action of the commissioners in letting the contract, are submitted to the Court:

"1. Conferring upon the clerk of the Superior Court the power to establish a levee or drainage district is invalid as constituting a delegation of legislative power and duty to the judiciary.

"2. The statute shows upon its face that it is for the benefit of private land-owners and not for a public purpose.

"3. As a levee or drainage district is a *quasi*-municipal corporation and the work is not a 'necessary expense,' within the meaning of Article VII, section 7, of the Constitution of North Carolina, a debt cannot be contracted 'unless by a vote of the majority of the qualified voters therein.'

"4. The contract should have been let to the lowest bidder in this case or the work should have been advertised for new bids.

"The foregoing propositions, so far as they involve the validity of the statute, are pointed to the provisions of the State and the United States constitutions, declaring that the legislative, executive, and supreme judicial powers of the Government ought to be forever separate and distinct from each other; that no person ought to be deprived of his property but by the law of the land or by due process of law; and that no municipal corporation shall contract any debt except for the necessary expenses thereof, unless by a vote of the majority of the qualified voters therein."

J. H. McMullan and T. H. Calvert for plaintiff.

Pruden & Pruden and Brown Shepherd for defendant.

HOKE, J. The power of the Legislature to create special taxing districts for public purposes, separate and distinct from the ordinary political subdivisions of the State, such as counties, townships, etc., was declared and approved in the case of *Smith v. School Trustees*, 141 N. C., 143, and like power to create special assessment districts has been upheld by the Court in several well-considered decisions. *Asheville v. Trust Co.*, 143 N. C., 360; *Busbee v. Commissioners of Wake*, 93 N. C., 143; *Commissioners v. Commissioners*, 92 N. C., 180; *Shuford v. Commissioners*, 86 N. C., 552; *Newsome v. Earnheart*, 86 N. C., 391; *Cain v. Commissioners*, 86 N. C., 8.

The principle has been frequently extended and applied to the creation of these drainage districts, and while certain statutes may have been declared void, this as a rule was because the rights of persons affected had not been in some way sufficiently safeguarded, and, so far as we have examined, the power of the General Assembly to enact legislation of this character has not been questioned. *Adams v. Joyner*, 147 N. C., 77; *Porter v. Armstrong*, 139 N. C., 179; *Pool v. Trexler*, 76 N. C., 297; *Norfleet v. Cromwell*, 70 N. C., 634; *Fall Brook v. Bradley*, 164 U. S., 112; *Warts v. Hoagland*, 114 U. S., 606; *Land and Stock Co. v. Miller*, 170 Mo., 240; *Morrison v. Morey*, 146 Mo., 543; *Lagima Drainage Dist. v. Mastin Co.*, 144 Cal., 209; *Cribbs v. Benedict*, 64 Kan., 555; *Bryant v. Robbins*, 70 Wis., 258.

Speaking of such legislation, and the reasons upon which it may be made to rest, *Rodman, J.*, delivering the opinion in *Norfleet v. Cromwell*, *supra*, said:

"The defendant takes higher ground, and contends that the act of 1795 was unconstitutional, because it took his property for a mere private purpose. It is admitted that that cannot be lawfully done, and the only question on this point is as to the character of the purpose: whether it was to the benefit of

one or of a limited number of individuals only, or of such general and public utility as justifies a State in the exercise of its power of eminent domain.

"It is well known that in the Atlantic section of this State there are hundreds of thousands of acres of what are called swamp lands, which, from the flatness of their surface and the filling up of the natural courses of drainage, if any ever existed, cannot be relieved of the water which ordinarily covers them, and made fit for human habitation and cultivation, except by cutting artificial canals from them into some convenient creek or river, which must necessarily pass through the intervening lands of the riparian proprietors. If these canals can be cut only by permission of the owners of the banks of the necessary outlets, this vast area of fertile land must remain for ages an uncultivated and unpopulated wilderness, and it will be entirely valueless to those who bought it from the State on the faith of its laws. An act which aims to remedy so great an evil, affecting so many persons now living and so many more in the future, must be deemed one of general and public utility. In an agricultural view, it now benefits the whole population of that part of the State in which these swamps are found. The right of the State to condemn lands for drains rests on the same foundation as its right in cases of public roads, mills, railroads, cartways, schoolhouses, forts, lighthouses, etc. In the case of public roads, it has never been doubted, and the weight of authority is decidedly in favor of its existence for the other purposes mentioned. Roads and aqueducts are classed together in the Institutes as servitudes of the same public character. In the swamps which the act in question chiefly affects, the canals are more important than the roads, as they must always precede them. The right to drain through the banks of a natural water course is exactly similar in character to the right to construct dykes or levees to keep their excessive waters from overflowing the adjacent lands—a right which has been recognized in the legislation of all countries from the most ancient times. Witness the dykes which protect the coast of Holland, the fens of Lincolnshire, the lands on the Mississippi and on the Po. Both purposes are classed together in our act of 1789.

"The act in question, and others of a like character respecting mills, etc., are of ancient date. They have been incidentally sanctioned by this Court in many decisions, and if their constitutionality has never been directly affirmed, it may be because it was never questioned. These acts are not peculiar to North Carolina. Acts concerning mills, similar to ours, exist in many of the States. (*Washburn Easements*, 394 [329]), and respecting drainage, at least, in Massachusetts (*Gen. Stat.*, ch. 148), and New York (2 *Rev. St.*, 548; *People v. Nearing*, 27 N. Y. [13 Smith], 306)."

The legislation in question here comes well within the principle established by these cases. It has evidently been prepared with great care, and seems to present a scheme for the drainage of these lowlands at once comprehensive, adequate, and efficient, and in which the rights of all persons to be affected have been fully considered and protected.

When these drainage districts are created under statutes like this we are now considering, they are regarded as public *quasi*-corporations, partaking to some extent of the character of a governmental agency, and for general purposes of taxation in the ordinary acceptation of the term, they come, as a rule, within the restrictions established by the Constitution upon municipal corporations in reference to the imposition of taxes, both as to the amount and

method. *Smith v. Trustees, supra*. But under our decisions these restrictive provisions as to taxation have been held not to apply to the case of local assessments, where, as in this case, such assessments are made and collected by some recognized method apportioning the burdens according to the benefits received by the property affected. *Busbee v. Commissioners, supra; Commissioners v. Commissioners, supra; Shuford v. Commissioners, supra; Newsome v. Earnheart, supra; Cain v. Commissioners, supra*.

In *Shuford's case* it was held: "1. A tax levied only upon land under the provisions of the 'stock law' (Laws 1879, ch. 135) is not within the constitutional prohibition as to uniformity of taxation, and hence the assent of the qualified voters of the district affected is not necessary; and this, even though the act of the Legislature styles it a *tax*.

"2. It is regarded as a local assessment, and made with reference to special benefits derived from the property assessed, from the expenditures, while taxes are public burdens, imposed as burdens, for the purpose of general revenue."

And in *Commissioners v. Commissioners*, 92 N. C., *supra*, Chief Justice *Smith*, on this subject, quotes with approval from the opinion in *Cain v. Commissioners* as follows:

"As the greater burden is thus removed from the landowner, he, as such, ought to bear the expense by which this result is brought about. The special interest benefited by the law is charged with the payment of the sum necessary in securing the benefit. This and no more is what the statute proposes to do, and in this respect is obnoxious to no just objection from the taxed land proprietor, as it is *free from any constitutional impediments*."

The objection urged, therefore, that no vote of the people on the proposition was required or provided for by the statute, must be overruled.

Nor can the further objection be sustained, that the act in question improperly undertakes to confer legislative power and duties on the clerk of the court, a judicial officer; for, on authority the duties and powers conferred on the clerk by this statute are of a judicial nature.

Speaking to this question, in 10 A. and E., at page 239, it is said:

"The better doctrine, however, seems to be that the duties of the municipal authorities, in determining the necessity for sewers (dependent on a like principle), their location and their general plan, are of a judicial or *quasi-judicial* nature, while the work of construction and maintenance is ministerial."

And authoritative decisions fully support the position as stated. *Johnston v. District of Columbia*, 118 U. S., 19; *Callen v. City*, 43 Kans., 627; *Bellingham Imp. Co. v. City*, 20 Wash., 53; *Wahoo v. Dickenson*, 23 Neb., 426. This disposes, we believe, of the objections urged against the validity of the statute.

It was further contended for plaintiff that, under the provisions of the law, the commissioners had no right to accept and award the contract to a higher bidder, but that "the contract should have been let to the lowest bidder, or the work should have been advertised for new bids"; but the language of the statute is that "they, together with the superintendent of construction, shall convene and let to the lowest *responsible* bidder," and the decisions are to the effect that when, by the clear import of this or similar language, a discretion is conferred, the action of the authorities will not be interfered with, unless the same was influenced or procured by fraud. *People v. Kent*, 160 Ill., 655; *Brick and Pav. Co. v. Philadelphia*, 164 Pa. St., 477; *Commonwealth v. Mitchell*, 82 Pa. St., 343; *Clapton v. Taylor*, 49 Mo. App., 117.

In *People v. Kent* it was held :

"1. The word 'responsible,' applied to an undertaking to pay money only, means financial ability; but in the statute for letting contracts for public improvements, which requires a 'responsible bidder,' it has the wider meaning of ability to respond to the requirements of the contract, having full regard to the subject-matter thereof.

"2. The requirement of a statute that contracts for a public improvement shall be let to the lowest *responsible* bidder does not require the letting of a contract to the lowest bidder upon the ascertainment of his *financial* responsibility only, but the term 'responsible' includes the ability to respond by the discharge of the contractor's obligations in accordance with what may be expected or demanded under the terms of the contract.

"3. The courts cannot interfere, in the absence of fraud, with the exercise of the official discretion of a public officer intrusted with the duty of awarding a contract, in determining whether a certain person was the lowest responsible bidder, after investigation of such person's record in doing similar business before."

And in *Clapton v. Taylor, supra*:

"2. In letting contracts for street improvements, the duty of city authorities is not wholly ministerial, but partakes sufficiently of a judicial character, in the absence of fraud or misconduct, to render their conclusion binding; and the law in regard to the letting of such contracts does not mean absolutely that the contract shall be given to the lowest bidder without regard to fitness, and the city authorities are presumed to have done, and not to have exceeded, their duty."

The case was submitted for our decision near the close of the term, with a request that an early decision be rendered, and we may have written somewhat hurriedly. Our investigations, however, have been very much facilitated by the excellent briefs submitted by counsel for both parties, and we desire to express appreciation of the commendable diligence they have shown in their preparation, and the great aid these briefs have been to the Court in reaching a satisfactory conclusion on the questions presented.

For the reasons stated, we are of the opinion that the judgment of his Honor below must be affirmed, and it is so ordered.

Affirmed.

PUBLICATIONS
OF THE
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
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8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
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12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
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18. Bibliography of North Carolina Geology, Mineralogy and Geography. with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents.*

19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*

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21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*

22. A Report on the Old Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp., 22 pl., 5 figs. *Postage 15 cents.*

ECONOMIC PAPERS.

1. The Maple-sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

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3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a List of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virginina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestone; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°. 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial

Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.

15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

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20. Wood-using Industries of North Carolina, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Postage 7 cents.*

21. Proceedings of the Third Annual Drainage Convention, held under Auspices of the North Carolina Drainage Association; and the North Carolina Drainage Law (codified). Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp., 3 pl. *Postage 5 cents.*

VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. The Physiography and Geography of the Coastal Plain Region of North Carolina. *In Press.*

BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *Postage 1 cent.*

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Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp. *Postage 2 cents.*

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Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp. *Postage 2 cents.*

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Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp. *Postage 1 cent.*

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Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Gives special report on an Examination of the Sand-banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders of Purdue University.

Biennial Report, 1900-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report, and contains Agreements for Co-operation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract; Buncombe County, Transylvania County State Farm, certain Watersheds, Reforestation of Cut-over and Abandoned Farm Lands, on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county-seats in North Carolina; list of Magnetic Declination at the county-seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a letter should accompany sample and stamp should be enclosed for reply.

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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

ECONOMIC PAPER No. 22

FOREST FIRES AND THEIR PREVENTION

INCLUDING

FOREST FIRES IN NORTH CAROLINA
DURING 1910

BY

J. S. HOLMES, Forester



RALEIGH
EDWARDS & BROUGHTON PRINTING COMPANY, STATE PRINTERS
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LETTER OF TRANSMITTAL

CHAPEL HILL, N. C., August 1, 1911.

To His Excellency, HONORABLE W. W. KITCHIN,

Governor of North Carolina.

SIR:—I herewith submit for publication as Economic Paper 22 of the reports of the North Carolina Geological and Economic Survey a report on Forest Fires and their Prevention, including statistics regarding Forest Fires in North Carolina during 1910, which has been prepared by Mr. J. S. Holmes, Forester to the Survey. The statistics are more complete and accurate than those collected for 1909 and more intelligent answers were received from inquiries during this second year of collection.

Yours respectfully,

JOSEPH HYDE PRATT,

State Geologist.

CONTENTS

	PAGE
INTRODUCTION	9
THE WEATHER IN 1910.....	10
TABULAR STATEMENT	10
Summary of Reports from Correspondents by Regions for 1910 and 1909.	
(Table 1.)	11
Coastal Plain Region (Table 2).....	12
Piedmont Region (Table 3).....	14
Mountain Region (Table 4).....	16
ANALYSIS OF TABLES.	
Comparative Statement of Averages by Regions for 1910 and 1909.	
(Table 5.)	17
Number of Fires	17
Area Burnt Over	17
Merchantable Timber Destroyed	18
Forest Products Destroyed	18
Improvements Destroyed	18
Number of Lives Lost.....	18
Cost to Fight Fires	19
LOSS FROM FIRES NOT INCLUDED IN TABLES.....	19
CAUSES OF FOREST FIRES.....	20
Tabular Statement of Causes in Percentages (Table 6).....	21
PREVENTIVE AND PROTECTIVE MEASURES	22
Private Measures	22
Co-operative Associations	23
Associations Chiefly Educational	24
Associations Chiefly Protective	24
State Measures	25
Present Laws	25
Proposed Laws	25
To Control Fires Set by Private Individuals.....	28
To Control Railroad Fires	29
To Organize a Fire Warden System.....	31
National Measures	33
Co-operation Under the Weeks Bill.....	33
EDUCATIONAL MEASURES	34
Arbor Day	35
Teaching Forestry in the Public Schools.....	37
Teaching Forestry in the Colleges.....	39
Lectures at Farmer's Institutes, etc.....	39
Forestry Associations	40
Demonstration Forests	42
CONCLUSION	42

FOREST FIRES AND THEIR PREVENTION

By J. S. HOLMES.

INTRODUCTION.

During 1909 the United States Forest Service attempted to collect uniform data on the prevalence and destructiveness of forest fires in all the various States. The North Carolina Geological and Economic Survey co-operated with the Forest Service in this work in this State, and got together some very interesting figures. Though admittedly incomplete, these were published by the State Survey in Economic Paper No. 19, "Forest Fires in North Carolina During 1909." This publication has been scattered widely through the State, and is still available for distribution. It should be read in connection with the present report in order to best understand the application of the figures and to obtain much information which it was thought best not to repeat.

Owing to the failure of many of the States to obtain sufficient reliable information, the general fire study of the Forest Service, which was intended to be annual and permanent, has been discontinued. The North Carolina Geological and Economic Survey then had to decide as to the advisability of continuing the collection of these figures unaided. Though the data collected last year was far from satisfactory, still it was thought that the economic and educational value of such figures was great enough to warrant the expense of collecting them. With the hope, therefore, of increasing their accuracy and broadening their influence, the Survey determined to continue the collection of this information in regard to the annual destruction by forest fires.

Accordingly, as soon as the year closed, question blanks were sent out to about eight hundred correspondents in all parts of the State, together with a stamped envelope for reply. These forms contained the same questions that were asked last year, but, in order to make the replies more definite and accurate, the correspondents were asked to confine their figures to one or more specified townships, and not try to estimate for the whole county. This method has succeeded much better even than was expected. No correspondent attempted to answer for more than one or at the most, two townships, and, as a consequence, the figures included in this report, though attempting to represent an even smaller part of the State than last year, are, it is thought, considerably more accurate. Still it must not be forgotten that all figures given are

estimates, and sometimes only very rough estimates at that, as it would have been impossible to obtain definite figures without an immense amount of trouble and expense.

THE WEATHER IN 1910.

As the condition of the weather, especially the amount and local distribution of the precipitation has a great deal to do with the frequency and severity of forest fires, a brief review of the weather conditions for 1910 will add interest and value to this report.

The past year was noteworthy for two quite severe droughts, extending over the entire State, though generally more severe in the eastern part. The greatest deficiency in precipitation occurred in March, the rainfall for that month being less than for any previous March for which there are any records. Practically no rain fell after March 12th. This droughty condition, which lasted up to the middle of April, and was accompanied by high winds, made the danger from forest fires very great. Destructive fires broke out in many counties before the end of March and continued with increasing frequency and severity up to the middle of April, when a general rain restored normal conditions. June was a wet month, the rainfall all over the State being markedly in excess of the normal. Heavy summer rains continued at intervals until September, when dry weather again commenced, though in the mountains rain fell generally until October. The fall drought lasted until December 3d. November was very dry, only about one-fourth of the normal rainfall occurring over the whole State. Very severe fires occurred during this season, both in the mountains and in the eastern part of the State. Altogether, the year 1910 showed a slightly greater rainfall than the previous year, though a little less than the normal amount of precipitation was recorded.

TABULAR STATEMENT.

The following tables have been compiled from the information furnished by voluntary correspondents all over the State. There was only one county which did not send in any report, and most counties were represented by three or four correspondents. This, it is realized, is quite insufficient to get complete reports, but it is enough to give some idea of the magnitude of the loss which is yearly experienced, and this, it must be remembered, is the chief object of these tables. It is hoped that another year the number of voluntary correspondents may be greatly increased, thereby enabling the Survey to publish much more complete figures.

TABLE 1.—FOREST FIRES IN NORTH CAROLINA DURING 1910. COMPARATIVE STATEMENT. SUMMARY OF REPORTS FROM CORRESPONDENTS BY REGIONS, FOR 1910 AND 1909.

	Mountain.		Piedmont.		Coastal Plain.		State.	
	1910.	1909.	1910.	1909.	1910.	1909.	1910.	1909.
Total number of townships in region	166	-----	450	-----	364	-----	980	-----
Number of townships reporting	51	-----	146	-----	131	-----	328	-----
Number of replies received	48	47	142	61	131	50	321	158
Number of forest fires reported	136	249	258	86	312	272	706	607
Total area burnt over, in acres	80,825	166,295	158,948	100,670	339,780	139,100	579,553	406,065
Total area growing merchantable timber burnt over, in acres	64,250	128,145	46,839	77,735	142,010	51,025	253,099	256,905
Total area of second growth, not yet merchantable, burnt over, in acres	7,190	13,100	55,712	14,555	78,735	27,050	141,637	54,705
Total area of cut-over land burnt over, in acres	9,385	25,050	56,397	8,380	119,035	61,025	184,817	94,405
Total standing timber destroyed in M. ft. bd. measure	6,915	17,325	12,553	11,027	42,550	9,280	62,018	37,632
Value of timber destroyed, in dollars	\$ 25,095	\$ 47,520	\$ 35,930	\$ 33,374	\$ 108,995	\$ 26,360	\$ 170,020	\$ 107,254
Value of forest products destroyed, in dollars	\$ 28,215	\$ 17,075	\$ 100,415	\$ 39,425	\$ 129,545	\$ 30,245	\$ 258,175	\$ 86,745
Value of improvements destroyed, in dollars	\$ 19,375	\$ 26,550	\$ 25,615	\$ 14,750	\$ 53,805	\$ 17,105	\$ 98,795	\$ 58,405
Number of lives lost	1	0	1	0	3	0	5	0
Cost to private individuals to fight fire	\$ 13,155	\$ 6,650	\$ 10,503	\$ 1,059	\$ 11,780	\$ 6,355	\$ 35,438	\$ 14,064

FOREST FIRES AND THEIR PREVENTION.

TABLE 2.—FOREST FIRES IN NORTH CAROLINA DURING 1910. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.
COASTAL PLAIN REGION.

Counties.	Total No. of Townships in County.	No. of Townships Reporting.	No. of Replies.	No. of Fires.	Area Burnt Over.					Merch. Timber Destroyed.	Value of Timber Destroyed.	Value of Products Destroyed.	Value of Improvements Destroyed.	Lives Lost.	Cost of Fire Fighting.
					Total Area Burnt—Acres.	Merch. Timber—Acres.	Second Growth—Acres.	Cut-over—Acres.							
Beaufort.....	6	2	2	4	3,000	1,500		1,500	5,000	\$ 7,500	\$	\$ 1,000			\$
Bertie.....	9	4	4	14	13,450	2,400	1,040	10,000	120	300	15,200	4,250			625
Bladen.....	15	6	7	14	15,900	10,700	3,200	2,000	10,950	20,300	12,800	1,500			800
Brunswick.....	6	3	2	11	25,500	10,200	300	15,000	900	2,100	200	5,050			25
Camden.....	3	2	2	0											
Carteret.....	9	2	2	7	15,000	9,000		6,000	1,400	2,700	2,000	1,000			50
Chowan.....	4	3	4	2	2,000		1,000	1,000							
Columbus.....	14	3	4	28	70,500	45,500	5,000	20,000	2,125	3,400	6,500	11,200		2	3,050
Craven.....	9	4	4	7	6,000	2,000	1,500	2,500	100	600	20,000				
Cumberland.....	12	7	6	37	53,200	21,150	20,650	11,400	4,320	18,300	6,300	11,000		1	2,550
Currituck.....	5	4	5	1											
Dare.....	5	3	3	0											
Duplin.....	13	5	5	6	1,090	520	50	520	255	2,800	3,350	455			225
Edgecombe.....	14	1	1	0											
Gates.....	7	5	4	15	3,650	2,225	725	700	3,020	6,660	14,030	1,220			1,100
Greene.....	10	3	3	1	10	10									
Halifax.....	12	3	3	16	3,250	600	1,150	1,500		6,000	1,500	1,000			210
Harnett.....	13	5	4	13	62,000	8,500	22,900	30,600	3,010	9,020	12,000	6,000			300

FOREST FIRES AND THEIR PREVENTION.

13

Hartford.....	6	4	3	5	450	400	50	100	350	5,000	250	1,500
Hyde.....	4	2	2	5	2,000	500	1,500	200	500	250		
Johnston.....	16	3	3	0								
Jones.....	7	1	1	2	10,000	10,000		500	1,000	10,000		
Lenoir.....	12	7	7	7	5,200	3,400	1,800	200	5,400	8,000	2,300	400
Martin.....	10	1	1	0								
Nash.....	12	5	4	8	1,400	600	350	90	350	450		60
New Hanover.....	4	1	1	12	1,000		500					
Northampton.....	9	2	3	3	25	25		10	30	30	100	25
Onslow.....	5	2	2	5	7,000	4,500	2,500	2,500			100	
Pamlico.....	4	5	4	21	14,175	4,160	3,000	7,015	3,020	685	150	25
Pasquotank.....	6	3	3	5	320	310	10	20	60		10	
Pender.....	10	1	1	3	5,000		5,000	200	200		100	50
Perquimans.....	5	3	3	4	350	200	50				20	
Pitt.....	11	6	8	14	9,800	1,000	5,700	5,000	16,000	5,180	5,075	50
Richmond.....	7	3	3	20	2,800	500	1,450	200	600		500	200
Robeson.....	19	3	3	4	1,500	1,000	500	80	160	100		75
Sampson.....	16	2	2	3	1,000	300	100	600	775	3,000	300	200
Scotland.....	4	1	1	2	2,000	300	200	1,500		2,000	1,000	
Tyrrell.....	5	1	1	0								
Washington.....	4	3	2	1	500	250	250					
Wayne.....	12	6	7	12	710	360	50	180	870	670	225	200
Wilson.....	10	1	1	0								
	364	131	131	312	339,780	142,010	78,735	119,035	\$108,995	\$129,545	\$ 53,805	3 \$ 11,780

TABLE 3.—FOREST FIRES IN NORTH CAROLINA DURING 1910. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES. PIEDMONT REGION.

Counties.	Total No. of Townships in County.	No. of Townships Reporting.	No. of Replies.	No. of Fires.	Area Burnt Over.					Value of Merch. Timber Destroyed.	Value of Timber Destroyed.	Value of Products Destroyed.	Value of Improvements Destroyed.	Lives Lost.	Cost of Fighting Fire.
					Total Area Burnt—Acres.	Merch. Timber—Acres.	Second Growth—Acres.	Cut-over—Acres.	Merch. Timber Destroyed—M.						
Alamance.....	13	6	5	5	3,100	1,000	1,000	1,000	50	\$ 400	\$ 1,000	\$ 1,000	\$		
Alexander.....	8	5	6	3	250	200	50		510	1,250	500	200			
Anson.....	8	0	0	0											
Burke.....	11	2	2	12	10,000	8,000	2,000		2,000	4,000					
Cabarrus.....	12	3	4	5						1,000					
Caldwell.....	12	4	3	9	5,300	2,100	1,000	2,200	300	600	1,200	1,100			300
Caswell.....	9	3	3	0											
Catawba.....	8	5	3	2	50	15		35		100					
Chatham.....	14	4	4	8	1,760	675	790	295	1,020	1,480	1,300	1,000			
Cleveland.....	11	3	3	3	50	18	22	10	50	125					
Davidson.....	17	6	5	4	34	14	1	19	2	180	20	5			
Davie.....	7	2	4	1	50	25	25				25	800			
Durham.....	6	1	1	1	100	75	25								
Forsyth.....	14	3	3	1	75		40	35					25	20	
Franklin.....	10	4	4	14	1,650	500	200	950	85	150	1,000	200			2,800
Gaston.....	6	3	2	1	40	15	25		80	400	400				
Granville.....	9	4	5	7	200	100		100			500				
Guilford.....	18	2	2	0											
Iredell.....	16	6	6	13	1,435	915	400	120	350	1,700	1,500	2,225			260

FOREST FIRES AND THEIR PREVENTION.

15

Lee.....	7	4	4	24	1,450	725	135	500	675	2,800	275	1,000	---	535
Lincoln.....	5	2	2	1	75	60	5	10	150	500	500	1,000	---	---
McDowell.....	10	5	5	16	19,500	9,750	8,000	1,750	145	3,665	2,800	550	1	1650
Mecklenburg.....	15	6	4	3	16	11	5	---	10	650	---	1,400	---	---
Montgomery.....	11	5	5	4	39,100	8,030	8,020	23,050	600	1,200	20	30	---	50
Moore.....	9	4	3	22	51,000	4,100	26,400	20,500	1,100	3,300	75,100	12,200	---	4,025
Orange.....	7	5	2	5	25	---	25	---	---	---	---	---	---	---
Person.....	9	3	2	1	50	30	10	10	---	---	---	---	---	10
Polk.....	6	6	8	38	12,900	5,300	4,000	3,600	290	530	5,040	460	---	65
Randolph.....	19	3	3	7	500	175	100	225	25	55	---	200	---	200
Rockingham.....	11	1	1	0	---	---	---	---	---	---	---	---	---	---
Rowan.....	14	5	6	5	500	200	90	210	---	---	---	2,000 (?)	1	100
Rutherford.....	12	2	1	7	600	---	600	---	---	---	---	---	---	100
Stanly.....	8	2	2	3	300	205	85	10	103	765	1,505	400	---	25
Stokes.....	8	4	4	6	320	158	109	53	5	30	10	---	---	---
Surry.....	14	4	4	0	---	---	---	---	---	---	---	---	---	---
Union.....	9	1	1	0	---	---	---	---	---	---	---	---	---	---
Vance.....	8	4	5	2	210	210	---	---	---	---	---	20	---	5
Wake.....	19	1	1	0	---	---	---	---	---	---	---	---	---	---
Warren.....	12	4	3	14	5,100	1,025	2,550	1,525	---	---	5,500	---	---	510
Wilkes.....	20	5	6	3	3,068	3,008	---	---	5,003	10,020	2,020	700	(?) 1	58
Yadkin.....	8	4	5	8	200	100	---	100	---	1,000	200	100	---	---
	450	146	142	258	158,948	46,839	56,712	56,397	12,553	\$ 35,930	\$100,415	\$ 25,615	5	\$ 10,503

TABLE 4.—FOREST FIRES IN NORTH CAROLINA DURING 1910. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.
MOUNTAIN REGION.

Counties.	Total No. of Townships in County.	No. of Townships Reporting.	No. of Replies.	No. of Fires.	Area Burnt Over.					Merch. Timber Destroyed.	Value of Timber Destroyed.	Value of Products Destroyed.	Value of Improvements Destroyed.	Lives Lost.	Cost of Fighting Fire.
					Total Area Burnt—Acres.	Merch. Timber—Acres.	Second Growth—Acres.	Cut-over—Acres.							
Alleghany.....	8	1	1	0											
Ashe.....	15	1	1	1	150	100		50	500	\$ 1,250	\$ 1,500	\$ 100			\$
Buncombe.....	13	5	4	6	1,300	1,000	150	150	300	900					100
Cherokee.....	6	2	2	25	4,000	4,000			10	50	500	200			
Clay.....	5	3	3	9	1,500	1,300	160	40	30	70	45				65
Graham.....	3	2	2	7	18,000	14,700		3,300	700	3,700	3,000	300			100
Haywood.....	13	6	6	17	5,100	3,190	1,050	860	1,000	3,000		5,000		1	10,205
Henderson.....	8	5	6	13	7,000	5,050	1,075	875	70	1,650	420	800			200
Jackson.....	15	2	2	25	10,000	10,000			200	1,000	1,000	25			25
Macon.....	11	6	4	14	10,000	9,000	1,000				10,000	1,000			1,000
Madison.....	16	2	2	2	1,100	900	100	100	2,000	4,150	50	50			510
Mitchell.....	14	5	5	4	4,900	4,400	500		5	15	1,000	1,700			450
Swain.....	5	2	3	6	7,200	3,200	1,600	2,400		1,210	10,700				500
Transylvania.....	9	2	2	3	75	10	55	10							
Watauga.....	14	6	4	4	10,560	7,400	1,500	1,600	2,100	8,100		10,200			
Yancey.....	11	1	1	0											
	166	51	48	136	80,825	64,250	7,190	9,355	6,915	\$ 25,095	\$ 23,215	\$ 19,375		1	\$ 13,155

TABLE 5.—COMPARATIVE STATEMENT OF AVERAGES BY REGIONS FOR 1910 AND 1909.

	Mountain.		Piedmont.		Coastal Plain.		State.	
	1910.	1909.	1910.	1909.	1910.	1909.	1910.	1909.
Percentage of townships reporting..	31	.....	32	.....	36	.....	33.5	.....
Average area of each fire, in acres..	594	668	616	1,171	1,089	511	821	667
Average damage by each fire, in dollars.....	631	393	668	1,030	974	294	775	439
Average area burnt over per township reporting, in acres.....	1,585	.....	1,089	.....	2,504	.....	1,805	.....
Average damage per acre, in cents.	1.06	.59	1.08	.88	.90	.57	.97	.66
Average cost to fight fires per acre burnt over, in cents.....	.16	.04	.06	.01	.03	.04	.06	.03½

NUMBER OF FIRES.

Of the 800 blanks sent out, only 320, or 41 per cent, were filled out and returned. Though these covered only one-third of the townships of the State, it is probable that they include the greater part of the more important fires, though many other fires have occurred in townships not reported on. This has been ascertained from clippings taken from the local press of the State, which mention additional fires in at least ten counties.

No doubt many fires also took place in townships making reports which the correspondents, owing to their location in a different part of the township, had not heard of.

From tables 1, 2, 3, and 4 it will be seen that 726 fires were reported, or an average of a little over two fires to the township reporting. This is only slightly in excess of the total number of fires reported for 1909. While there were barely half the number of fires reported from the mountain region, there were nearly three times as many in the Piedmont region as were reported for 1909. This is probably due in large part to the two droughts, which were so severe over the eastern part of the State, and which were much less felt in the mountains. The comparatively small number of replies received from the western part of the State might also partly account for it.

AREA BURNT OVER.

About 580,000 acres of land were reported burnt over during 1910. This is 43 per cent in excess of the amount burnt over last year. The comparative freedom of the mountain counties from fires shows itself in the 80,000 acres burnt over, which is less than half that was burnt over in that region in 1909.

Nearly half of the burnt-over area of the State was supporting a growth of merchantable timber, though probably the greater part of it had been culled to some extent. The division of the area into merchantable timber, second growth, and cut-over, is only approximate and can not be taken as definite figures. Nearly all merchantable timber in the hardwood forests contains more or less second growth, while a great part of the cut-over lands also contains much young growth. Such figures, therefore, can not be accurate, and are of use chiefly in giving some idea of the damage done by fires.

MERCHANTABLE TIMBER DESTROYED.

The amount of merchantable timber destroyed, compared with the area burnt over containing such timber, appears to be very small. This is due to the fact that, as a rule, mature timber is not killed outright by the ordinary forest fires in this State, unless the fire occurs in the late spring. Most fires, however, do seriously injure mature standing timber, and often the death of timber which is attributed to insects is really primarily caused by forest fires. In spite of this, however, there is a reported loss of 62,000,000 feet of merchantable timber from fires. This is nearly twice as much as was reported destroyed in 1909.

FOREST PRODUCTS DESTROYED.

The value of forest products destroyed in 1910 is about three times as much as that listed for 1909, and amounts to over a quarter of a million dollars. This includes sawlogs, lumber, cordwood, bark, and other material.

Although this large item of loss is no doubt much below the real figure, it is, however, enough to make people realize the advisability of taking active steps to prevent such fires.

IMPROVEMENTS DESTROYED.

Farm improvements, chiefly fences and outbuildings, are included under this head. Ninety-eight thousand dollars was lost by the destruction of this class of property alone, more than half of it in the Coastal Plain region. This, as will be seen from Table 1, is also largely in excess of that of 1909.

LIVES LOST.

The year 1910 will long be remembered as one of the most destructive to life and property from forest fires throughout the country. During the month of August scores of lives were lost in the forest regions of the northwestern States.

Though we are apt to think that our fires are altogether different from those in the West, yet a loss of five human lives through forest fires occurred in North Carolina in 1910. Besides the woman burnt in Cumberland County, referred to in last year's report, a colored girl and an old woman were burnt to death in Columbus County while trying to protect their property from the flames. Two men lost their lives fighting fire in the western part of the State, one in Haywood County, and the other one near Marion in McDowell County. Such deaths are usually spoken of as accidental, but they are preventable accidents, for they would not have occurred had it not been for the criminal carelessness of those who let the fires get out.

COST TO FIGHT FIRES.

More than \$35,000 was spent by private individuals and lumber companies in 1910 in extinguishing forest fires, or two and a half times the amount spent the previous year. This does not comprise the total cost of fighting fire even in the townships reporting, for, as a rule, small fires and those on private land are fought, when any effort is made to extinguish them, by the voluntary help of the neighbors. A glance at the figures in Table 5 shows that about sixteen cents per acre burnt over was spent in the Mountain region to fight fires, while only about three cents per acre was spent in the Coastal Plain. This does not mean that the mountain people are not willing to fight fire unless paid for it, for they are just as ready as any one else to assist their neighbors in such emergencies. It means that the lumber companies and other timberland owners of that region are more alive to the destruction caused by fire than those of the Coastal Plain region. This is partly because many owners of mature timber in eastern North Carolina still burn to protect their timber from more destructive conflagrations, but chiefly because many of the eastern lumbermen own the timber without the land, and so have no interest in protecting the young growth, while those in the Mountain region usually own both land and timber and are anxious to keep fire out. It is an encouraging sign that while twice as much was spent in 1910 in fighting fires in the mountains as was spent in 1909, only half as great an area was burnt over. While the weather was in part responsible for this there is no doubt that the increasing watchfulness and effort on the part of landowners is bringing results.

LOSS FROM FIRE NOT INCLUDED IN THE TABLES.

A loss of considerably over \$500,000 in one-third of the townships of the State seems a large sum, and yet it is far from representing the

entire damage, even of the fires that were reported. The injury to the standing timber which is not killed is often just as heavy as that caused by the destruction of the trees.

The damage done to young growth and reproduction is usually considerably greater than that done to the mature timber, but as it is in most cases difficult to put a cash value on this young growth, because it has no sale value, it is usually left out of all estimates of damage. There is now, however, a tendency to take into account the young growth destroyed by a fire, as is evidenced by two correspondents; one in the mountains, who estimated a loss of \$5 per acre in the destruction of young growth; the other on the coast, who put down a loss of \$1,000 in young growth, caused by burning over 500 acres of land. These, which are no doubt very conservative estimates, go to show that some landowners are realizing the loss to the future forest that is taking place. Next year an attempt will be made by the Survey to get correspondents to include damage to young growth by furnishing question blanks with a space for this purpose.*

The gradual killing out and disappearance from the forest of such valuable species as poplar, white pine, and chestnut, and the substitution for them of the inferior, though more fire-resistant kinds, means a serious loss to the landowner which will be appreciated more thoroughly by the next generation because the change is comparatively slow. Such a loss is hard to estimate for any one year, but it will manifest itself in the gradual decline in the value of the property.

The gradual, though certain, impoverishment of the soil through the constant burning of the leaves, causes great loss in the value of the land on which the forest is growing. This loss shows itself in the slower growth of the trees and in the decline in value of the land for agricultural purposes.

The washing of the soil by the rains is one of the forms of damage caused by forest fires. The coating of leaves protects the top soil, and when this is removed the rains rush off to the streams, removing the surface soil, and filling up the streambeds with silt and sand, thereby damaging the land and seriously interfering with the navigability of the streams.

CAUSES OF FOREST FIRES.

The principal causes of forest fires, as given by the various correspondents for their own townships, have been compiled and are given in percentages in Table 6.

*Damage to young growth from forest fires is discussed pretty fully in Economic Paper 19, "Forest Fires in North Carolina During 1909," page 25.

TABLE 6.—CAUSES OF FOREST FIRES IN THE DIFFERENT REGIONS OF NORTH CAROLINA IN 1910, IN PERCENTAGES.

	1910.				1909.
	Mountain	Piedmont.	Coastal.	State.	State.
Farmers burning brush, grass, rubbish, etc.....	8	23	7	13	10
Hunters.....	2	6	6	6	16
Cigars, cigarettes, matches, etc.....		5	2	3	3
Carelessness and negligence of individuals.....	11	23	22	20	15
Railroad locomotives, sparks from.....	18	13	27	20	17
Logging locomotives, dummy engines, etc.....	8	3	15	9	5
Sawmills, etc.....		10	2	5	3
Traction engines.....		3		1	
Accidental, caught from burning buildings, etc.....		2	1	1	1
To improve the range.....	8	1	3	3	4
Set by chestnut gatherers, root diggers, etc.....		1			2
Without much object, to see it burn, etc.....	13			2	13
Malice or incendiary.....	16	6	7	9	4
Unknown causes.....	16	4	8	8	7

This table shows that over three-fourths of the fires reported from all over the State were thought to be unintentional. Forty-two per cent of all the replies given by correspondents can be classified under the head of individual carelessness, which is practically the same figure as was obtained last year. In the Piedmont region, however, where burning to improve the range is practically eliminated as a cause of fires, fifty-seven per cent of the correspondents attributed the fires to individual carelessness. Farmers burning brush, grass, stumps, and rubbish are said to be responsible for about one-third of these "individual" fires, while probably a majority of those attributed to general carelessness should come under this head. This is by far the most frequent cause of fires originating from the individual. More care in the setting of such fires, and watching them till they are burned out and harmless, would prevent many of the most serious and destructive fires.

Sparks from engines is a very fertile cause of forest fires, over one-third of the correspondents giving this as the principal cause in 1910. Railroad and logging locomotives are the chief offenders, twenty-nine per cent of all the correspondents accusing them. This is considerably more than fell to their share in 1909. These railroad fires are in large part preventable, and as soon as property owners along the lines of railroads unite in demanding protection, it can be secured.

According to the above table, intentional fires are most frequent in the Mountain region, where thirty-seven per cent are said to be purposely set. This is a large proportion, though it is an improvement over the report for the previous year, which showed that in the mountains nearly half the fires were set on purpose. This large number of intentional fires is in part due to the destructive habit of burning the woods to "improve the range" for loose cattle, which ought to be confined to their owner's land, and in part to an unfortunate feeling of antagonism in some localities against large landowners who are trying to protect their forests. The large increase in malicious or incendiary fires all over the State is a regrettable feature of the 1910 figures and one that is not easy to explain. It indicates very clearly, however, that more stringent laws and better law enforcement are needed in order to check this nuisance.

PREVENTIVE AND PROTECTIVE MEASURES.

We have in North Carolina a reported loss from forest fires in 1910 of \$560,000. This report covers only one-third of the townships of the State, and does not include injury to standing timber, damaged, but not killed; to young growth; to soil and streams by any of the fires. There can be little doubt, therefore, that the total loss through forest fires in North Carolina during 1910 amounted to at least a million dollars. In addition to this there was very serious loss of life from the same cause. Is it not time that North Carolina as a State, and we as individuals, took some steps to abate this nuisance?

If there was any one measure that would stop these fires we could easily be persuaded to adopt it, but, unfortunately, there is no such specific. There is, however, much that we can all do and the following preventive and protective measures are strongly advocated.

PRIVATE MEASURES.

The owner of woodland, whether a corporation or a private individual, can do much towards protecting his property from fire, though to achieve the greatest success all such efforts should have the hearty co-operation of the community and the State. Fire lines cleared out around or through a property are very effective in stopping a moderate fire. When a strong wind is blowing and the fire is very heavy, such a fire line is invaluable as a vantage ground from which to start a back fire. Adequate fire lines can be constructed at from \$10 to \$50 per mile, according to the nature of the ground over which it has to be made. Such a fire line has been made over the rough mountain country of northeast McDowell County at less than the higher figure.

Patrol is probably the most effective single means that the individual can put into practice, though quite expensive. Efficient patrol will cost from one to three cents per acre per year. Some companies, especially in the mountainous part of the State, employ one or more men to look after their forest land, and often part of their duty is patrolling. If this were more generally practiced many fires would be prevented, and many more extinguished before they had gotten beyond control.

Warning notices, calling the attention of the passers-by to the danger of forest fires, are used to a large extent in the National Forests of the West, and are employed on many of the private or corporate holdings in the North and East, and to some extent in the South, though in this State they are little used, except to include a prohibition against setting fire to the woods in a general trespass notice. A carefully-worded reminder, posted where it will be seen and read, is calculated to help materially in suppressing the "careless" fire.*

Farmers can do much to prevent the disastrous spring fires by burning in the winter as much as possible what brush and rubbish it is necessary to remove in this way, and by never leaving even an innocent-looking fire until it is quite out. Renters, who very often own no land and are absolutely irresponsible, should be bound by a contract not to set out fire in dry weather. If every renter who let fire escape and burnt up his landlord's woods were in the future denied a place to rent in that neighborhood, this class of offenders would learn to be more careful.

A stipulation against setting fire to the woods should always be included in a contract for the sale of timber. There is no more reason for the purchaser of mature timber to destroy all the reproduction and young growth on the ground by fire than there is for a man who buys the apple crop to cut down and destroy an orchard in order to harvest the fruit, and the sooner landowners realize this the better it will be for their interests.

CO-OPERATIVE ASSOCIATIONS.

Co-operation between individuals for the purpose of fire protection adds very much to the effectiveness of private efforts. The individual suffers as much and sometimes more from fires that start beyond his boundary than from those originating on his land; especially if he is patrolling and his neighbor is not. No matter how careful a man may be or how much he spends on fire protection, the fires that originate and develop great headway before they come onto his property, can not be controlled. Besides the attainment of efficiency through co-operation,

*Fire lines, fire patrol and fire notices are more fully discussed in Economic Paper 19, "Forest Fires in North Carolina During 1909," pp. 43-47.

the cost of protection is reduced to a minimum. One man can patrol much more territory if he feels responsible for all the area that comes within his vision than if he has to look out for boundary lines and his operations are restricted. Some form of co-operation is essential for the most successful fire-fighting.

The value of co-operative associations has been pretty clearly demonstrated in several of the far western States during the past two or three years. Two separate kinds of associations for forest protection have been formed; the one chiefly educational, the other engaging in the actual protective work.

Associations Chiefly Educational:—The Oregon Forest Fire Association is a representative of this class. It does not itself engage actively in fire work, but is a rather loose affiliation of individual patrol systems, each doing its fire work independently, but using the central facilities for legislative and publicity purposes and particularly to stimulate the installation of further individual patrols. The formation of local co-operative patrol associations is also encouraged. In fact, its main purpose is for the general promotion of patrols in the State, of giving out information regarding the best methods of protection, endeavoring to induce the public to be more careful in the use of fire, and trying to persuade owners to maintain patrols. There is a large amount of work of this nature to be done and it will help the general movement, but of course, the only way to prevent fires is to have patrolmen on the ground. Such an association denotes a less advanced stage in co-operative effort—for a large number of independent patrols cannot equal systematic co-operative management of the work in either economy or results—nor does it have the same public standing. Moreover, without actual work to do the association finds it hard to gain members or preserve its solidarity. Such an organization in North Carolina would not be of the greatest value. The field is covered already, to a certain extent, by the North Carolina Geological and Economic Survey, which is only kept from doing much more in this line by lack of funds.

Associations Chiefly Protective:—What is wanted among timberland owners in North Carolina is a close organization which can go ahead and carry out patrol and other means of protection. This is being done in the northwest by the Washington Forest Fire Association and the several Idaho timber protective associations, which latter, it is generally conceded, afford the most efficient protection in the country. The organization of these Associations includes a board of directors who have power to levy and enforce the payment of assessments to defray expenses in proportion to the number of acres owned by each member.

The actual work of protection is put in the hands of a committee which hires patrolmen and fire fighters and incurs all other expenses necessary to protect the territory from forest fires. In one of the most successful of these Associations the patrol averages one man to sixteen thousand acres, and although they have had some hazardous seasons their loss has always been very small. It is figured that it is a better policy to maintain a close patrol to discover small fires when they first start than to cut down the expense of the patrol, and then rely upon putting a large force of men on to fight fire after it gets well started. The cost of this association averages about three cents per acre per year, though on account of a very exceptional season it went over that in 1910. The total cost of the Washington Forest Fire Association was 2.3 cents per acre in 1910, and only 1.4 cents in 1909, though much more than the acreage belonging to members was patrolled, in order to better protect their own lands.

Not only do these associations do their own protective work, but they co-operate with the State and National Governments in fire protection. In North Carolina there is a large opening for this feature of their work. The State has at present no fire-fighting force with which to co-operate, but it is hoped that this will be provided for by the next Legislature. The U. S. Department of Agriculture, however, is anxious to spend part of the amount provided for co-operation with States by the Weeks bill in fire protection in North Carolina. It was suggested that the basis of such co-operation might be furnished by a Forest Protective Association working through the State Geological and Economic Survey. It has been decided, however, that this does not come within the meaning of the Act.

There are endless ways in which the activities of such an Association could work for the better protection and consequent enhancement in value of our forests, and the timberland owners of the State are recommended to look thoroughly into this question and, if possible, make trial of this method of protection.

STATE MEASURES.

Present Laws.

In 1777 the General Assembly of North Carolina passed a statute making it unlawful for any one to set fire to the woods, except it be his own property, and in that case not without first giving two days notice in writing to adjoining property owners. After 134 years this law still remains on our statute books, the best and practically the only law we have on the subject. In its present form in The Revisal of 1905 it reads:

3346. *Woods*.—If any person shall set fire to any woods, except it be his own property, or, in that case, without first giving notice in writing to all persons owning lands adjoining to the woodlands intended to be fired, at least two days before the time of firing such woods, and also taking effectual care to extinguish such fire before it shall reach any vacant or patented lands near to or adjoining the lands so fired, he shall, for every such offense, forfeit and pay to any person who shall sue for the same fifty dollars, and be liable to any one injured in an action, and shall moreover be guilty of a misdemeanor.

The law therefore forbids setting fire to woods, even though it be one's own property, without giving two days notice in writing to adjoining landowners. This law is rarely enforced, because the "two days notice in writing" is considered an impractical measure, and also because the strong objection among most people to prosecuting their neighbors acts as a deterrent. One of the most frequent causes of fire, that from burning brush while clearing up new grounds in the spring, is not covered by this law, for the courts have held that these "new ground" fires do not come within the statute. This law is susceptible of considerable improvement and should be amended.

Since the great extension of railroad facilities all over the State, the practice of hauling farm crops and merchandise long distances to market, which used to be the universal custom, has almost ceased. In the rougher and more remote parts of the State, however, where more than one day's trip is required to reach the market the abandoned camp-fire is still a menace. That North Carolina has a law against leaving such fires unextinguished is often not known by wagoners, and a notice quoting the following section posted near frequented camping places would often be of great advantage to the passer-by, as well as a safeguard to the property owner.

3347. *Woods, from Camp Fires*.—If any wagoner or other person encamping in the open air shall leave his camp without totally extinguishing the camp fires, he shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not exceeding fifty dollars, or imprisoned not exceeding thirty days.

These two laws, the most important dating back some 130 years, constitute the present working forest-fire laws of North Carolina. Even these, however, are rarely enforced.

In order to ascertain as nearly as possible to what extent these laws were being carried out, the North Carolina Geological and Economic Survey asked all their forest-fire correspondents the following question: "Has any one, so far as you know, been prosecuted for setting fire to forests in your county or township during the past year? If so, with what result?"

This question was answered in the negative by 195 of the correspondents. Out of the 218 who answered this question usually in one word as "No," "None," or "Nobody," only 23 mentioned any action being taken against those who set out fire, and of these only nine could have been brought under the law against setting fires, the rest being civil suits for damages, chiefly against railroads and lumber companies. The sum total of convictions, for the careless or intentional setting of at least 700 fires in this State during 1910 is four; two in the mountains, in which the parties were "fined light, say \$5 each and costs," and two in the Coastal Plain region, one of whom was let off by paying "good" costs; and the other, to the honor of Pitt County be it said, was given the maximum fine, \$50 and costs. The other suits were, in the words of the correspondents, "Nol prossed," "Compromised, defendant paying \$37.50 damages," "Case before grand jury, but no bill found," "Not a true bill," "Case not yet tried."

The apparent inefficiency of the law is due to the inadequacy of the laws themselves and to the indifference of the people in the matter of burning the woods. This is well illustrated by the following replies from a few of the correspondents in answer to the above question in regard to prosecutions under the fire laws: "Not one. We need more stringent laws as to the careless handling of fire"; "No one. Need more laws"; "Cannot get sufficient proof to get true bill or convict"; "Nobody prosecuted, everybody seems to be afraid to prosecute for fear of being burned out"; "I think not. It would be difficult to convict as it is a 'sport' engaged in by a large percent of our people"; "No; but ought to have been"; "Don't know of any. They are hard to catch and hard to convict in a fence-law territory"; "One was threatened with prosecution"; "No; only for want of officers to enforce the law."

The General Assembly of 1909 passed a law allowing the Governor, at his discretion and on application of the owner, to declare any wooded land which lies above 2,000 feet above sea level a "State forest." The Governor may then, at the request of the owner, appoint such forest wardens as the owner of the land may request, said wardens to have the power of arrest without warrant and to be paid entirely by the owner. For this privilege the landowner pays an annual tax of half a cent per acre into the county treasury for the benefit of the school fund.

No property owner has yet taken advantage of this law, and it is practically a dead letter, the owners probably thinking that the efficiency gained by giving the wardens power of arrest is not worth such a substantial tax.

Proposed Laws.

As we have previously seen, the largest number of fires are due to the carelessness or indifference of individuals, and to the negligence of railroads, lumbermen, and other operators of engines. In order to successfully cope with this situation, we need: (1) Better laws to control the private citizen; (2) Stricter regulations controlling the railroad and other engine users; (3) A system maintained by the State, or the State and counties together, to properly enforce the forest-fire laws. These three features may be combined in one act, as was done in the bill which was introduced into the last Legislature, or they may be passed as three separate acts, as is here proposed.

Fires Set by Private Individuals.—The present law, which has previously been given, should be amended to include grassland, but the two days written notice required should apply to woods only, or should be eliminated altogether. By broadening the second section to make it include hunters and other persons, some approach to controlling that fertile source of forest fires would be made.

In New Jersey and several other States to the north and west of us, the burning of woods, brush, stumps, rubbish and other material is not allowed during a dry season, and in some cases throughout the year, without a written permit from the proper officer. This has been found to work well in preventing fires, especially the destructive early spring fires. In North Carolina, however, we are hardly ready for such a law. A law to compel all who burn material to watch it till it is extinguished would seem to meet a definite need and would be more easily enforced.

The following suggested bill contains all of the above features:

A BILL TO BE ENTITLED AN ACT TO PROTECT THE FORESTS OF THIS STATE FROM FIRE.

The General Assembly of North Carolina do enact:

SECTION 1. That section three thousand three hundred and forty-six of The Revisal of one thousand nine hundred and five be amended to read as follows: If any person shall set fire to any grassland, brushland or woodland, except it be his own property, or, in that case without first giving notice to all persons owning or in charge of lands adjoining to the land intended to be fired, and also taking care to watch such fire while burning and taking effectual care to extinguish such fire before it shall reach any lands near to or adjoining the land so fired, he shall for every such offense be guilty of a misdemeanor and be fined or imprisoned in the discretion of the court. This shall not prevent action for damages sustained by the owner of any property.

SEC. 2. That section three thousand three hundred and forty-seven of The Revisal of one thousand nine hundred and five be amended to read as follows:

Any wagoner, hunter, camper or other person who shall leave a camp-fire without fully extinguishing it, or who shall accidentally or negligently, by the use of any torch, gun, match or other instrumentality, or in any manner whatever, start any fire upon any grassland, brushland or woodland, without fully extinguishing the same, shall be guilty of a misdemeanor, and upon conviction shall be punishable by a fine of not less than twenty-five dollars nor more than fifty dollars or imprisoned not exceeding thirty days.

SEC. 3. All persons, firms or corporations who shall burn any tar kiln or pit of charcoal or set fire to or burn any brush, grass or other material whereby any property may be endangered or destroyed, shall keep and maintain a careful and competent watchman in charge of said kiln, pit, brush or other material while burning. Any person, firm or corporation violating the provisions of this section shall be guilty of a misdemeanor.

Railroad Fires.—The railroads and lumber companies, though great offenders, having caused probably one-third of the fires in the State in 1910, are also great sufferers, being generally held responsible for injury and made to pay damages. A few of the replies to the question asking about prosecutions are here quoted: "Railroad paid for several acres of timber"; "Railroad compromised, nothing done about the rest"; "No; the railroad people always pay damage"; "The railroad has paid about \$1,000"; "No; Railroad Company paid about \$2,000"; "The Railroad Company goes over the ground and sees how much it burns over, and pays about thirty-five cents per acre"; "Set by traction engine, and damage paid"; "Lumber Company sued for \$5,000"; "Lumber Company forced to pay damages"; "Suit entered against one lumber company." These prosecutions are, of course, as said before, brought under the civil law, and do not invoke the present fire laws. They do, however, show that it is as much to the interest of the railroads as to that of the owners of woodland that fires should be prevented. Until there is some general demand, however, that the railroads take necessary precautions, they prefer to drift along in the old way, paying damages now and then,—the average cost of which they know—rather than advocate new laws, which, though they might save them money, still would cost them an unknown amount to carry out. When reasonable laws are once passed the railroads will undoubtedly co-operate actively in their enforcement, trusting thereby to cut down their large annual bill of damages.

During the last session of the Legislature the following bill was drawn up, after careful discussion and criticism of every point by the representatives of the people and of the railroad and lumber companies. It was at first introduced as part of the general forestry bill, but was later drawn up as a separate law. It is in this form that its passage by the next Legislature is strongly urged.

A BILL TO BE ENTITLED AN ACT TO REQUIRE THE RAILROADS OF THE STATE TO TAKE CERTAIN PRECAUTIONS FOR THE PREVENTION OF FOREST FIRES.

The General Assembly of North Carolina do enact:

SECTION 1. All persons, firms or corporations operating any railroad, logging road or tramroad through woodland within this State shall keep their right of way cleared of all combustible materials within a horizontal distance of one hundred (100) feet, nowhere to exceed one hundred and fifty (150) feet surface measurement, from the outer rail on each side of the track, by burning or other method. Combustible material, as referred to in this act, shall be construed to mean only such brush, grass, leaves or other material that would ordinarily become ignited from a spark from the engine. When the right of way owned does not extend to the width of the cleared space or fire line herein required, the right is hereby granted to said persons, firms or corporations to enter upon adjoining lands not owned by them, for the purpose of clearing off and maintaining the cleared space or fire line herein required. If any landowner should object to the clearing off and maintenance of the fire line herein required, he shall not be entitled to collect any damages thereafter occurring from fires caused by sparks from the engines of said persons, firms or corporations. Each railroad, logging road or tramroad affected hereby shall be required to clear off each year not more than one-fifth (1-5) of the total length of the fire line required by this section until all has been completed, and shall continue to keep such fire line clear after it has once been cleared off. The part of the mileage to be cleared off by such railroad shall be designated by the Geological Board after conference with the proper officer of such railroad, logging road or tramroad. Any railroad wilfully violating the provisions of this section shall be liable to a penalty of not less than ten (\$10.00) dollars or more than twenty-five (\$25.00) dollars for every mile or fraction thereof of fire line not cleared according to the provisions of this section: *Provided*, that this section shall not be construed to prohibit or prevent any railroad company from piling or keeping upon the right of way, crossties or other material necessary in the operation or maintenance of such railroad or materials intended for shipment over such railroad: nor is it intended to require the removal of buildings, fences or other necessary or valuable improvements from the fire line herein required: *Provided further*, that the notice to the adjoining landowners required by section three thousand three hundred and forty-six of The Revisal of one thousand nine hundred and five shall not apply to any burning necessary to carry out the provisions of this section: *Provided further*, that nothing in this section shall be construed to require the railroad company to clear the fire line on property not owned by said company should the owner object, and no failure on this account shall be charged against the railroad company as a violation of this act.

SEC. 2. When engineers, conductors or trainmen employed by any railroad discover that fences or other material along the right of way or woodland adjacent to the railroad are burning or in danger from fire, they shall report the same promptly at the next telegraph or telephone station at which the train is scheduled to stop, or at any other stops necessary in the operation of the train. The reporting of such fires shall not be construed to mean that the railroad companies making such report are responsible for such fires, nor shall such report be used in evidence in a suit arising from such fire, but is simply for the purpose of giving information as to the existence of a fire. In seasons of drought the rail-

road companies shall give instructions to their section foremen for the prevention and prompt extinguishing of fires originating on their right of way, and they shall cause warning placards, furnished by the Geological Board, to be posted at their stations in the vicinity of forest lands. Any railroad company wilfully violating the requirements of this section shall be guilty of a misdemeanor, and railroad employees wilfully violating the requirements of this section shall be guilty of a misdemeanor.

SEC. 3. For the purpose of this act woodland is taken to include all forest areas, both timber land and cut-over land, and all second growth stands on areas that have at one time been cultivated.

This law requires the railroads to clear off a strip 100 feet wide on each side of their track, where it runs through woodland. It has been demonstrated after careful study that most of the live sparks from railroad locomotives fall within the zone between 50 and 100 feet on each side of the track, and very few fall beyond that distance. Keeping this strip clear would then prevent most of the fires caused by railroads and logging roads, which, as we have seen above, constitute about one-third of the fires in the State.

Fire Warden System.—The most important problem in the formulation of forest laws is providing effective machinery for putting them into force. Eighteen States have already organized fire protective systems, the purpose of which is to enforce the forest-fire laws of these States. Little or nothing has been accomplished in States without such systems, though several, like our own, have some excellent laws. A fire warden system generally consists of district, township, or county wardens, who, as a rule, are responsible to some one State official, either the State Forester, the State Forest Commissioner, or State Fire Warden, who is specifically charged with fire-protective work and usually also with the forestry work of the State. It is the duty of the wardens to extinguish fires, arrest offenders against the fire laws, investigate the causes of fires, post warning notices against fire and in some cases to patrol the forests during dry weather. They are paid by the State, or by the county, or by the State and county combined, usually by the hour or day, for the time actually employed. In fixing a rate of payment, care is taken not to make it high enough to tempt unscrupulous men to set fire to the woods with the object of drawing pay for extinguishing it. This practice may, of course, be occasionally resorted to, even where the pay is not high, but an efficient county fire warden would soon discover the perpetrators or at least have his suspicions aroused, and one or two drastic sentences, upon conviction, would put a stop to the practice. There are many counties in North Carolina where fire wardens are not

needed, but in counties having fifty per cent and over of their area in woodland they would quickly pay for their cost. If only a few counties were given the advantage of such a law to start with, the demand for fire wardens would rapidly spread, as their usefulness became apparent. The following bill, in a somewhat different form, was introduced into the Legislature of 1911, but failed to pass, chiefly because a special tax of half a cent per acre on all woodlands in the State was asked, to provide revenue for its enforcement. This method of raising the necessary money is perfectly fair and equitable, but until the system can be inaugurated and tested in those counties that most need fire protection, it is thought that a direct appropriation would be much simpler and more practicable.

A BILL TO BE ENTITLED AN ACT TO AUTHORIZE THE APPOINTMENT AND PAYMENT OF FOREST WARDENS.

The General Assembly of North Carolina do enact:

SECTION 1. On petition of four or more owners of timber lands in any one township, owning in the aggregate five thousand acres or more, or the owners of one-third of the forest land in the township, the county commissioners shall appoint, subject to the approval of the Geological Board, a forest warden for that township and as many deputy forest wardens to act with him as the Geological Board may deem necessary for the proper enforcement of this act. All forest wardens and deputy forest wardens must be legal residents of the counties in which they are employed.

SEC. 2. Forest wardens and deputy forest wardens shall have charge of measures for controlling forest fires; they shall make arrests for violations of the forest laws; shall post along highways and in other conspicuous places copies of the forest fire laws and warnings against fires which shall be supplied by the Geological Board; and they shall perform such other duties as shall be considered necessary by the Geological Board for the protection of forests. The forest wardens of the township in which a fire occurs shall within ten days make such report thereof to the Geological Board as may be prescribed by them. Each deputy forest warden shall promptly report to wardens any fire in his district.

SEC. 3. Any person who shall maliciously or wilfully destroy, deface, remove or disfigure any sign, poster or warning notice, posted by order of the Geological Board under the provisions of this or other act for the purpose of protecting the forests in this State from fire, shall be guilty of a misdemeanor and upon conviction shall be punishable by a fine of not less than ten dollars or more than fifty dollars or imprisoned not exceeding thirty days.

SEC. 4. Any person discovering any forest fire shall immediately give notice to the nearest forest warden or deputy forest warden in that or adjoining townships. All able-bodied male persons between eighteen and forty-five years of age can be summoned by forest wardens or deputy forest wardens to assist in extinguishing forest fires and shall be paid for such services at a rate not to exceed fifteen (15) cents per hour. Any person summoned by a forest warden or his deputy and not attending, without reasonable excuse, shall be subject to a fine of five (\$5) dollars.

SEC. 5. Forest wardens and deputy forest wardens shall have the same power as deputy sheriffs, so far as the provisions of this act are concerned. Neither forest wardens nor their deputies shall be liable for trespass while acting in the performance of their duties, nor shall any person be held guilty of trespass for going on lands when summoned by an officer to control fire.

SEC. 6. Forest wardens and deputy forest wardens shall receive compensation from the State at the rate of twenty cents per hour for the time actually engaged in the performance of their duties and reasonable expenses for equipment and transportation incurred in fighting or extinguishing any fire, according to an itemized statement to be rendered the Geological Board every month and approved by them. Forest wardens shall render to the Geological Board a statement of the services rendered by the men employed by them or their deputy wardens, as provided in this act, within one month of the date of service, which said bill shall show in detail the amount and character of the service performed, the exact duration thereof, the name of each person employed, and any other information required by the Geological Board. If said bill be duly approved, it shall be paid by direction of the Geological Board out of the State Treasury; and the State Treasurer is hereby authorized and required to collect one-half of the wages and expenses incurred by the forest wardens and deputy forest wardens under this section and section three (3) of this act, from the county in which they are incurred.

SEC. 7. The sum of ten thousand dollars annually is hereby appropriated, out of any moneys in the treasury not otherwise appropriated, for the purpose of carrying out the provisions of this act, the same to be drawn upon as directed by the Geological Board.

NATIONAL MEASURES.

Co-operation Under the Weeks Bill:—With the recent passage by Congress of the Weeks Bill (Pub. No. 435) "to enable any State to co-operate with any other State or with the United States for the protection of the watersheds of navigable streams, etc." an opportunity has been opened to secure fire protection, for at least the mountain portion of the State, at one-half the actual cost of such protection. This bill provides, among other things, as follows:

SEC. 2. That the sum of two hundred thousand dollars is hereby appropriated and made available until expended, out of any moneys in the national treasury not otherwise appropriated, to enable the Secretary of Agriculture to co-operate with any State or group of States, when requested to do so, in the protection from fire of the forested watersheds of navigable streams; and the Secretary of Agriculture is hereby authorized, and on such conditions as he deems wise, to stipulate and agree with any State or group of States to co-operate in the organization and maintenance of a system of fire protection on any private or State forest lands within such State or States and situated upon the watershed of a navigable river: *Provided*, that no such stipulation or agreement shall be made with any State which has not provided by law for a system of forest fire protection: *Provided further*, that in no case shall the amount expended in any State exceed in any fiscal year the amount appropriated by that State for the same purpose during the same fiscal year.

Under this law the Federal Government is empowered to co-operate with the various States in the organization, direction, and extension of a fire protective system, by putting in a sum of money equal to that appropriated by the State for this purpose. It can, however, only co-operate with States which have some form of State fire protection already. North Carolina has no such system, and though the Federal officials have showed a strong desire to spend part of this money in this State, nothing can be done to take advantage of this proffered co-operation until a regular State system of fire protection can be established. Should the Legislature in 1913 pass a law like that suggested on pages 32-33, appropriating \$10,000 for fire protection, an equal sum might, under the Weeks law, be procured from the Federal Government, making \$20,000, with which a good start could be made towards the prevention of forest fires in North Carolina.

Owners of forest land should make every effort to take advantage of this great opportunity by seeing to it that men actively in favor of forest protection are nominated and elected to the next General Assembly.

EDUCATIONAL MEASURES.

The majority of our people have been raised where there was always abundance of wood for fuel and for other local necessities, and where the selling of timber off the land has been looked upon as something extra made over the ordinary income. Timber has never been rated at its true value, namely, its cost value to grow, because there has been abundance of timber ready grown to our hand. It is not strange then that there is so much indifference to the growing necessity of fire protection. Economic conditions have been changing so rapidly of late years that it is only those who are in close touch with the markets of the country and who are studying the progress of events that realize the necessity for conservation of our forests.

A campaign of education along these lines must be carried on all over the State, not only to show the property owners themselves and the other grown citizens that it is to their interest and that of their children to protect and perpetuate the forests; but also and probably chiefly, to educate the children, to bring them up to realize that a new condition exists, and that the trees and the forests are really growing crops, and very necessary and valuable crops, and that as such they require care and attention as much as any farm crop.

The children of today are the property owners and lawmakers of tomorrow, so while we do not cease to advocate forest protection amongst the present-day citizens, let us at the same time train our future citizens to appreciate its necessity.

ARBOR DAY.

Probably the best and most attractive as well as the most practical way just at present, to inculcate a knowledge and love of trees among even the smallest children, is to make the observance of Arbor Day an annual feature in all the schools of the State. This would reach all of the children of the State once each year and would give them information in a form in which it would be remembered.

Few children, or grown people either for that matter, can distinguish a longleaf from a shortleaf pine seedling, know the conditions most favorable for the best growth of even our commonest forest trees, or can tell one oak or one pine from another by the bark, the buds, the leaves or the fruit.

In order to foster a love of trees among children and to teach them elementary facts about them, as well as to encourage the planting of trees and the intelligent care of forests by their elders, the practice of observing Arbor Day has been introduced into nearly every State in the Union, and in many States it is a legal school festival. In North Carolina the day was observed as far back as 1893, but unfortunately it has never received general recognition. Only a school here and there has observed the day with appropriate exercises, when some of the teachers or patrons have been especially interested in the subject.

In 1896 the School Committee of the town of Durham passed a law providing:

SECTION 1. That the second Friday in April of each year shall hereafter be known in the Durham Public Schools as Arbor Day.

SEC. 2. In order that the children in our public schools shall assist in the work of adorning the school grounds with trees, shrubs and flowers, to develop and stimulate a love and reverence for nature, to inculcate economic and æsthetic purposes which will result in beautifying the home and increasing the comfort and happiness of our people, it shall be the duty of the Superintendent of Schools to provide for and conduct such exercises as shall best accomplish these results.

An Arbor Day program was prepared and published in a twelve-page leaflet. This program, as carried out on April 10, 1896, is here given, by headings, in order to convey to those who have never attended such a celebration some idea of how attractively it may be carried out.

DURHAM PUBLIC SCHOOLS.

ARBOR DAY.

ASSEMBLY HALL, APRIL 10, 1896.

1. Music Orchestra
2. Arbor Day Song.
3. Responsive Exercises (in the words of Scripture).

4. Prayer (to be recited in concert).
5. MusicOrchestra
6. Class Exercise, Telling About Arbor Day.
 - (a) What is Arbor Day?
 - (b) Tell something of the origin of Arbor Day.
 - (c) Why do we observe Arbor Day?
 - (d) Why do you name your trees for some celebrated person?
 - (e) How are books and trees related?
 - (f) Tell me something about tree religion.
 - (g) What about trees as living things?
 - (h) Why should the forests be preserved?
 - (i) What do we get from the forests?
 - (j) You haven't told me anything about flowers.
 - (k) What trees do you think the best for school grounds?
 - (l) Tell me how to plant a tree, size, etc.
7. Some Things said About Observing Arbor Day.
8. Song of Dedication.
9. Reading—The Tree of the Field is Man's Life.
10. Reading—The Talk of a Tree.
11. MusicOrchestra
12. Recitation—Selections from Bryant, Irving, Emerson, and others.
13. Recitation—Resolution Protesting Against the Destruction of Trees.
14. Exercise—The Arbor Day Queen.
15. Reading Letters About Arbor Day from Distinguished North Carolinians.
16. Recitation—The Woodman and the Tree.
17. MusicOrchestra
18. Song—The Chorus of the Flowers.
19. Acrostic—Arbor Day.
20. Song—Love of Nature.
21. March—Washington Post.
22. Exercises at the Tree.

(Pupils from each schoolroom march to the school grounds, five of the class carrying spades, the handles being decorated with school colors—white and orange—and form a circle around the spot where the tree is to be planted.)

 - (a) Placing the tree in position.
 - (b) Tree planting Song.
 - (c) A brief statement by the teacher concerning the person to whom the tree is dedicated.
 - (d) Recital of quotations from writings of persons thus honored.
 - (e) Pupils place the soil around the tree with their spades.
 - (f) March to class room.

Recently the Forester of the North Carolina Geological and Economic Survey was invited to make an address at an Arbor Day celebration at Southern Pines, in which the whole town took a gratifying interest. The Civic Club, an organization of the women of the place, was the prime mover, while the teachers and the school children united with the club to make the occasion a great success. Trees and shrubs were

planted on the school grounds in the morning and in the afternoon drills, songs, and recitations, illustrating the child's relation to the trees and flowers around him, were very well given by the children in the large school auditorium.

Such a celebration might be held annually by every school in the state with great profit to the children, and with increasing interest on the part of the parents. There is a growing tendency among the men to leave the education of the children more and more to the women, and the next generation will have special cause to bless their mothers for opening their eyes to the beauty and usefulness of the trees if the women, who, through their clubs are doing such good work for civic improvement and the betterment of education, would take up this matter all over the State and work for a general Arbor Day observance.

In most States some special day is selected as Arbor Day by the Governor or Superintendent of Education, or some other authority, and all schools are expected to observe that particular day. In North Carolina, where the school year varies so in the different counties, and where the time for planting trees varies with the different regions of the State, it would probably be better for each County Superintendent, or even each School Principal, to set the day which would be most convenient to him and most appropriate to the season and locality. Where only a summer and fall school session is given, October in the mountains, November in the Piedmont section, and December in the eastern part of the State would be suitable times, while where a nine or ten months school is the rule, March or April would be more suitable, as children, and older folks too, for that matter, naturally turn to the woods and fields in the spring-time. Some Friday would usually be selected as interfering less with the routine of school work, though such interference really often turns out to be rather a help than hindrance to the work.

FORESTRY IN THE PUBLIC SCHOOLS.

There are two ways in which Forestry can be taught in the Public Schools without adding another course to the already crowded curriculum: first, by means of an auxiliary reader; and second, by correlating the various phases of Forestry with those courses taught in the school which are naturally connected with it.

1. The present system in North Carolina requires the use of "basal" readers in the various grades. These are supplemented by auxiliary readers on a great variety of subjects, such as: geography, household economics, etc. The use of these is optional, the County Superintendent or the Principal deciding on the subject which will be most helpful

to each particular class. So far there is no auxiliary reader on the subject of Forestry, or even on the more general and comprehensive subject of Conservation. There is room for a book of this character, and it is to be hoped that one will shortly be provided. Such a book should set forth in simple language the fundamental principles of Conservation and then show how these are related to the economics of everyday life.

2. In his circular "Forestry in the Public Schools" (Circular 130, Forest Service, U. S. Department of Agriculture), Prof. Hugo A. Winkenwerder advocates and outlines plans for the study of Forestry in connection with studies which are already being taught. He states that the object of this circular is to indicate to teachers who are interested the courses in which Forestry deserves a place and to assist them in choosing the proper subject-matter. A description of the location, extent, and character of the forests of the locality in which the teaching is done, of the State, and of the country as a whole, should form part of the study of geography as taught in all the common or secondary schools of North Carolina. Their economic value as sources of useful products, for conservation of water, for protection, and their influence on erosion and soil protection, as well as their æsthetic value, should be brought out as well as the necessity of forest protection, especially for protecting them from fire. Nature study, where it is taught, opens the way for some elementary forestry; in fact, the study of the trees, the shrubs, and the seedlings found in the woods is the most attractive form of nature study, and develops very rapidly the habit of observation, which is the chief object aimed at in all such training.*

In the High Schools, along with United States History, can be taught the importance of the forests to our development, the growth of the forestry movement, and of the National Forest Policy. The protection of forest property and the policies relating to public lands should form a part of the course in Civics. A course in physical geography is not complete without considering the relation of forests to climate; the influence of forests upon water and soil conditions; the relation of forests to erosion, and to reclamation. Commercial geography must include the importance of forests as a national resource, the distribution of forests, the products of the forest and the influence of forestry on commerce. It is impossible to enumerate the opportunities which the forest offers to teachers of botany.

In the farm-life schools and others of a similar nature practical forestry should be one of the important studies, and the school-farm should

*A special circular, "Forestry in Nature Study," issued by the U. S. Department of Agriculture, gives outlines of instruction in this subject for all terms and grades in the public schools.

furnish sufficient area in woods to give practical work in forest management. Nearly all North Carolina farms contain a large proportion of woodland, and it is as important for farmers to know how the yield may be increased on this as on the cleared land.

FORESTRY IN THE COLLEGES.

In order to bring this important problem before the young men who are yearly leaving our higher institutions of learning to take part in the management of the State, courses in Forestry should be given in all our colleges and in the State University. Complete courses are not required, but enough should be taught to give the students some idea of the forest problems that confront us and the best way to deal with them. In the A. & M. Colleges more complete instruction should be given; courses calculated to give the student a knowledge of how to manage a wood-lot, how to measure and sell standing timber and log it if necessary, how to protect the forest from fire and insects, what trees to plant and how, when, and where they should be planted. According to the President of the A. & M. College, who would be glad to add a course in Forestry to the curriculum, only one additional man would be required for this purpose. The same is true of the State University. Courses in Botany, Entomology, and Engineering are now given at both institutions. By adapting such courses to the needs of the forester and then founding a Chair of Forestry proper, which would include silviculture, forest management, and lumbering, an excellent course in Forestry could be given. Funds for the foundation of such a chair, however, are not available at either place, and probably will not be until a more general demand for such a course is made. The timber crop is second only in importance to the cotton crop in North Carolina, and most farmers have a larger acreage in woodland than in all other crops combined. It seems, therefore, that more recognition should be given this subject in our State Agricultural College, as well as in the State University.

LECTURES AT FARMERS' INSTITUTES, ETC.

It is not only through the Farm Schools and the A. & M. College that the State is trying to teach the farmer improved methods. For several years past it has been sending experts to all the counties of the State to lecture on improved methods of farming, from soil improvement to poultry-keeping. The timber crop is the only subject that has been entirely omitted from the list of subjects discussed. A talk on forest management or forest protection should be included in every program, for the subject is of the greatest importance to most farmers. Latterly the

Forester of the North Carolina Geological and Economic Survey has joined one of the parties in the western part of the State for a short time each summer and talked to the meetings on this subject, but this is only a very small beginning. An extension of this work all over the State is strongly advocated.

But lecture-work need not be confined to the colleges and the farmers' institutes. Addresses should be made all over the State as opportunity offers, and forest protection advocated before all kinds of audiences. Not till the people begin to think about the subject will they realize the importance of immediate action.

FORESTRY ASSOCIATIONS.

On February 1, 1911, a Forestry Convention met in Raleigh for the purpose of discussing proposed forestry legislation. Though the attendance was not large it was quite representative. Delegates from eighteen counties of North Carolina were present, including lumbermen, furniture manufacturers, railroad men, timberland owners, farmers, foresters and educators. The forestry bills then before the Legislature, were discussed in detail, and much interest was shown in them, as well as in a State-wide stock law. A new forestry bill was drawn up at the meeting, which it was recommended be substituted for the two already introduced. This bill, which combined all the features in the three laws suggested on pages 28, 30, and 32, was later introduced in both houses, but failed to pass. The following resolutions were adopted by the convention:

WHEREAS, It has been estimated that there is in North Carolina sufficient forest land to maintain perpetually a supply of raw material for our furniture factories, our pulp mills, and our tanning extract plants, if these forests are conserved and protected from fire; and,

WHEREAS, The forests of North Carolina and the industries dependent upon them represent about one-sixth of the wealth of North Carolina; and,

WHEREAS, These forests are being devastated by frequent fires, causing enormous present and future loss to the owners of forest land and indirectly to the people throughout the whole State; therefore,

Be it resolved, That we thoroughly endorse legislation that will protect our forests from fire, and urge the General Assembly to pass such measures as will enable those portions of the State that desire it, adequate fire protection for their forests; and as the best results can only be obtained when the stock law is in force,

Be it further resolved, That we endorse a State-wide stock law for North Carolina, with a provision allowing any territory voting for that purpose to be exempted therefrom upon erecting proper fence around such exempted territory.

Be it further resolved, That we advocate the teaching of the principles of forestry in the public schools and the introduction of a course in forestry in the A. & M. College.

Such a meeting as this is calculated to do a great deal to advance the cause of forest protection by awakening interest in the question and by unifying effort. With these ends in view it was unanimously decided to organize the convention into a permanent body to be known as the North Carolina Forestry Association, this association to have a President, Secretary-treasurer, and one Vice-President for every Senatorial District in the State in which sufficient interest in forestry had been manifested. The work of the Association was placed in the hands of an Executive Committee, consisting of the President, Secretary-treasurer, and five other members, to be appointed the first year by the president of the Association. The object and aim of the association was declared to be "the protection and perpetuation of the forests of North Carolina." Dr. D. H. Hill, of the A. & M. College, Raleigh, was elected President of the Association, and Mr. J. S. Holmes, Forester of the North Carolina Geological and Economic Survey, Chapel Hill, Secretary-treasurer. The President subsequently appointed the following gentlemen as members of the Executive Committee: Col. B. Cameron, Raleigh; Mr. Clarence Poe, editor *Progressive Farmer*, Raleigh; Dr. J. H. Pratt, State Geologist, Chapel Hill; Mr. H. M. Shaw, president Southern Wheel Company, Oxford; and Mr. E. B. Wright, manager Butter's Lumber Company, Boardman, N. C. The very fact that such prominent men are behind this movement speaks well for its future success and usefulness, and also inspires the confidence of the public in any recommendations it may make.

The organization of county or district associations, in connection with this State Association, to stir up and direct local sentiment, would do more to make the society effective and to forward the forestry movement than any other kind of work that could be undertaken. The good roads movement has received its greatest impetus from town and county good roads associations, though the State organizations have done splendid work. In the same way local forestry clubs, societies, or associations, or forestry branches of other bodies, acting in accord with the State Association, may do a great work in educating the people to a realization of the importance of forest protection. There are forestry sections of several of the women's clubs in the State that are doing good educational work, and the number might, with advantage, be increased. Different phases of forestry will appeal to different organizations; street planting to civic clubs, protection of watersheds and regulation of stream flow to Chambers of Commerce and Boards of Trade, perpetuation of the timber supply to labor organizations and lumbermen, the management of the wood-lot to Farmers' Clubs; but protection of the forests from fire should appeal to all.

DEMONSTRATION FORESTS.

One method of educating the public in improved methods of forest management which is widely practiced in Europe and has been adopted by several of the northern States is by the proper management of State Forests. In different parts of the State areas of land of larger or smaller extent are acquired by gift or purchase, or reserved by the State for the purpose of demonstrating the most practical form of management for that particular locality and for that kind of forest, and on which to conduct experiments to determine practical questions in forest management. In many cases land is given or bequeathed to the State by public-spirited citizens for this purpose.

If the people can be shown the results of proper treatment of the forests in successful fire protection, conservative lumbering, profitable tree planting, and advantageous thinnings, more would be accomplished than by countless lectures and bulletins. On an area in the high mountains experiments might be made to determine the best way to cut spruce for pulp while insuring the perpetuation of these forests. In the mountain hardwood forests methods to increase the proportion of poplar, chestnut, and other valuable species in the second growth might be demonstrated. In the Piedmont region the profits in judicious thinning of shortleaf pine stands could be shown. In the Coastal Plain region successful reproduction of longleaf pine might be demonstrated and experiments made to determine whether longleaf or loblolly pine was the most profitable tree to grow on certain types of soil. On "the Banks" the fixation of drifting sand by forest growth could be shown by planting up the sand dunes, and the profitable use of such areas made apparent by propagation of turpentine yielding pines. All such demonstrations, besides their value for experiments and for showing improved methods of forest management, involve, of necessity, adequate fire protection, and the successful accomplishment of this alone would make the acquirement and management of such demonstration forests justifiable, and fully compensate the State for their cost.

CONCLUSION.

Reports from correspondents in but one-third of the townships of the State give an estimated area of 580,000 acres of woodland burnt over during 1910, with a consequent loss of over half a million dollars in timber and personal property. If the losses from this cause in the remaining townships could be ascertained, and the enormous damage to young growth, soil and streams could be computed, it is very certain that the total loss to North Carolina by forest fires for the past year

would reach a million dollars. Not only this, but a loss of five human lives was caused directly by these same fires, which were in large part due to carelessness, and might and should have been prevented.

In 1909 the damage from forest fires amounted to several hundred thousand dollars, and every year it is much the same, and will continue to be the same until North Carolinians wake up and take some active steps to stop this destruction.

There is pressing need for more effective laws to protect the forests from fires resulting both from the railroads and from individuals. Such laws when enacted must have the support of the people, or they can not be efficiently enforced. What is needed in this as in other lines of business is education. The timber crop is second only in importance to the cotton crop in North Carolina, and occupies ten times the acreage of that staple, yet there is not one school or college in the State in which even elementary forestry is taught. Is it any wonder that the people show such indifference to forest destruction? A more general interest in forest protection must be aroused and more definite knowledge of practical forestry methods imparted to both the young and the older citizens of the State, and this can best be done by teaching the principle of forestry in our schools and colleges.

PUBLICATIONS
OF THE
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp. 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp. 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Waterpowers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895, 8°, 47 pp., 5 pl., *Postage 4 cents.*
10. Gold Mining in North Carolina and Other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*
11. Corundum and the Basic Magnesians Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 6 cents.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. Waterpowers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*
21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
22. A Report of the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp. 22 pl., 5 figs. *Postage 15 cents.*

ECONOMIC PAPERS.

1. The Maple-sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestones; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum, Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.

15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

19. Forest Fires in North Carolina During 1909, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pl. *Postage 5 cents.*

20. Wood-using Industries of North Carolina, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Postage 7 cents.*

21. Proceedings of the Third Annual Drainage Convention, held under Auspices of the North Carolina Drainage Association; and the North Carolina Drainage Law (codified). Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp., 3 pl. *Postage 5 cents.*

22. Forest Fires and their Prevention, Including Forest Fires in North Carolina During 1910, by J. S. Holmes, Forester, 1911. 8°, 48 pp. *Postage 5 cents.*

VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. The Physiography and Geography of the Coastal Plain Region of North Carolina. *In Press.*

BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Gives special report on an Examination of the Sand-banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders, of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report, and contains Agreements for Co-operation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract; Buncombe County, Transylvania County State Farm, certain Watersheds, Reforestation of Cut-over and Abandoned Farm Lands, on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinchurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county-seats in North Carolina; list of Magnetic Declination at the county-seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to duteh or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE EXAMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a letter should accompany sample and stamp should be enclosed for reply.

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of *postage* needed, as indicated above, for mailing the bulletins desired, to the *State Geologist, Chapel Hill, N. C.*

**THE NORTH CAROLINA GEOLOGICAL AND
ECONOMIC SURVEY**

JOSEPH HYDE PRATT, State Geologist

ECONOMIC PAPER No. 23

THE MINING INDUSTRY

IN

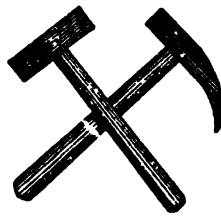
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BY

JOSEPH HYDE PRATT, Ph.D.

AND

MISS H. M. BERRY



RALEIGH

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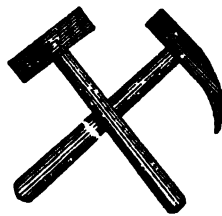
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1911

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LETTER OF TRANSMITTAL.

CHAPEL HILL, N. C., November 15, 1911.

*To His Excellency, Hon. W. W. KITCHIN,
Governor of North Carolina.*

SIR:—I herewith have the honor to submit for publication as Economic Paper No. 23, a Report on the Mining Industry in North Carolina for the years 1908, 1909, and 1910.

Yours respectfully,

JOSEPH HYDE PRATT,
State Geologist.

TABLE OF CONTENTS.

	PAGE
Introduction.....	9
Gold and silver.....	10
Production.....	17
Copper.....	19
Copper ores of the Virgilina District of North Carolina and Virginia:	
Introduction.....	19
Geography and geology.....	20
Location.....	20
Geology.....	20
The veins and ores.....	22
Summary and conclusions.....	23
Production.....	28
Iron.....	29
Production.....	30
Tin.....	30
Abrasive materials.....	31
Production.....	31
Mica.....	31
Report by Douglas B. Sterrett on North Carolina mica deposits.....	32
Characteristics of mica.....	33
Distribution of deposits.....	36
General geology.....	37
Occurrence of mica.....	37
Description of mines:	
Macon county.....	40
Jackson county.....	45
Transylvania county.....	53
Haywood county.....	53
Buncombe county.....	54
Yancey county.....	56
Mitchell county.....	58
Watauga county.....	60
Ashe county.....	61
Rutherford county.....	63
Wilkes county.....	64
Cleveland county.....	64
Lincoln county.....	65
Stokes county.....	66
Origin.....	67
Production.....	68
Quartz (Flint).....	70
Barytes.....	70
Production.....	71
Monazite.....	72
Extract from the report of Douglas B. Sterrett.....	72
Geography.....	73
Physiography.....	74
Geology.....	74
Formations.....	74
Structure.....	76
Weathering and soils.....	76
Occurrence of monazite.....	77
Placers.....	77
Residual deposits.....	78
Monazite in rock formations.....	78
Origin of monazite.....	80
Summary.....	81
Production.....	81

	PAGE
Zircon.....	83
Production.....	83
Talc and pyrophyllite.....	83
Production.....	84
Precious stones.....	85
Beryl.....	86
Emerald beryl.....	86
Aquamarine and golden beryl.....	90
Thulite.....	91
Amethyst.....	91
Garnet.....	93
Production.....	93
Mineral waters.....	94
Derita mineral springs.....	95
Sherrill or Sossaman springs.....	95
Rocky river springs.....	96
Production.....	96
Graphite.....	98
Coal.....	98
Dan river fields.....	99
Deep river fields.....	100
Peat.....	103
Notes on peat industry by Charles A. Davis.....	104
Tendency of European progress in production of peat.....	105
Stone.....	110
Granite.....	111
Production.....	111
Sandstone.....	112
Production.....	112
Marble and other forms of limestone.....	112
Marble.....	112
Limestone.....	114
Production.....	115
Sand and gravel.....	116
Production.....	116
Sand-lime brick.....	116
Production.....	119
Clay.....	120
Kaolin.....	121
Pottery clay.....	122
Fire clay and pipe clay.....	123
Brick clay.....	123
Summary.....	127
Mineral production by counties.....	127
List of publications.....	131

LIST OF ILLUSTRATIONS.

PLATE	FACING PAGE
I. Specimens of mica of various structure.....	33
FIGURES	PAGE
1. Map showing areas in North Carolina in which mica has been mined.	33
2. Plan of Burningtown or Poll Miller mine, Macon County, N. C.....	41
3. Plan of Hall and Welch mines, Macon County, N. C.....	42
4. Plan of Neal Bryson mine, Macon County, N. C.....	43
5. Plan of Winecoff mine, Macon County, N. C.....	45
6. Plan of John Long mine No. 1, Jackson County, N. C.....	45
7. Section in plane of the "vein" at the Painter mine, Jackson County, N. C.....	46
8. Plan of Piney Mountain mine, Jackson County, N. C.....	47
9. Plan of Wayehutta kaolin and mica mine, Jackson County, N. C.....	48
10. Roda kaolin and mica mine, Jackson County, N. C. (a) Plan; (b) details of tunnel 3, shown in (a).....	50
11. Jim Wood mine, Jackson County, N. C. (a) Cross section; (b) section in plane of the "vein".....	51
12. Uneven contact of pegmatite and mica gneiss at the Gregory mine, Jackson County, N. C.....	51
13. Plan of Judge Ferguson mine, Jackson County, N. C. Mign., Mica gneiss.....	52
14. J. H. Rochester mine, Jackson County, N. C. (a) Plan view; (b) cross section.....	53
15. New Balsam Gap mine, Buncombe County, N. C. (a) Section showing pegmatite pinched down to 10 inches and elbowing out abruptly; (b) irregularity of pegmatite exposed in end of tunnel; lenticular-shaped cross section with small side stringer and horse of mica gneiss.....	54
16. A, Plan of Connally mine, Buncombe County, N. C.; reference figures described in text. B, section in east wall of tunnel at (a) in A. C, Section in east wall of tunnel at (b) in A.....	55
17. A, Plan of Poll Hill mine, Yancey County, N. C. B, Cross section of pegmatite at end of incline at (a) in A.....	56
18. Vertical cross section of pegmatite at Hensley mine, Yancey County, N. C.....	57
19. Section in plane of pegmatite at Knob mine, Mitchell County, N. C.....	58
20. Plan of the later workings at the W. W. Wiseman mine, Mitchell County, N. C.....	59
21. Plan of Charlies Ridge mine, Mitchell County, N. C.; figures give elevations above mouth of new tunnel. The position of the pegmatite is shown on the 55 and 65 foot levels; also the probable position at the level of the end of the tunnel.....	59
22. Plan of North Hardin mine, Ashe County, N. C.....	62
23. Plan of workings and probable shape of the pegmatite in Isinglass Hill mine, Rutherford County, N. C.....	63
24. Plan of Joe Hawkins mine, Stokes County, N. C.....	66
25. Ideal cross section at Hole mine, Stokes County, N. C.....	67
26. Map showing area of monazite deposits of known commercial value in southern Appalachian region.....	73
27. Hand specimen of monazite-bearing rock from British Monazite Company's mine, 3 miles northeast of Shelby, N. C. Three-fourths natural size.....	79

PREFACE.

The very long delay in the publication of the report on the Mining Industry for 1907 is the reason why the statistics for 1908 and 1909 were not given in separate reports, when collected.

In order, however, that the statistics of the production of the various minerals might be available, Press Bulletins were published in 1909 and 1910, giving these statistics for the previous years.

The statistics for all minerals, except gold, silver, and copper, have been collected in coöperation with the United States Geological Survey. The figures for gold, silver, and copper, however, have been obtained mainly by statistic cards sent out by the State Survey and through information courteously given by Mr. Frank Drane, of the United States Assay office at Charlotte. The Survey wishes to express its appreciation to all the mineral producers of the State who have so courteously and generously assisted in making the compilation of this report possible.

JOSEPH HYDE PRATT,
State Geologist.

MINING INDUSTRY IN NORTH CAROLINA DURING 1908, 1909, AND 1910.*

By JOSEPH HYDE PRATT AND MISS H. M. BERRY.

INTRODUCTION.

The financial panic and general business depression which was felt all over the country during the latter part of the year 1907 had a very marked influence on the mineral production in North Carolina for the succeeding years, and the value of the mineral production for 1908 was nearly a million dollars less than for 1907. There has, however, been a steady increase since 1908, and, in the year 1910, the value of the mineral production of North Carolina almost regained the figures of 1907.

Of the metallic minerals, iron holds first place in the table of production and gold and silver next. The panic of 1907 caused the price of copper to decline very markedly, and in 1908 very little copper ore was sold. The 1909 production was considerably more than in 1908, but in 1910 the copper production again declined, due to the low price of this metal.

Of the non-metallic minerals, clay products, building stones, mica, and talc are prominent in their production in the order named. There has been a considerable decrease in the production of monazite owing to the fact that thorium salts are imported cheaper than they can be produced in this country.

On the whole it will be seen that the mining and quarrying industries of the State regained in a great measure the loss sustained from the financial panic of 1907, as was evidenced in the production of 1908, and it is believed that in 1911 the mineral production will regain, if not surpass, that of any previous year.

There is given in the table below the production of each mineral produced in North Carolina from 1906 to 1910, inclusive; where there were less than three producers, the mineral is included under "Miscellaneous."

*The statistics given in this report with the exception of those for gold, silver, and copper were collected by the State Survey in cooperation with the U. S. Geological Survey.

THE MINERAL PRODUCTION IN NORTH CAROLINA FOR THE YEARS 1903-1910,
INCLUSIVE.

Mineral	1906	1907	1908	1909	1910
Gold.....	\$ 122,003	\$ 82,195	\$ 97,495	\$ 43,075	\$ 68,586
Silver.....	30,944	14,299	668	324	4,888
Copper.....	135,829	116,416	2,560	29,186	17,845
Iron.....	75,638	113,488	76,877	107,013	114,237
Pyrite.....					
Garnet.....					
Corundum.....		13,500		9,188	7,961
Millstones.....	4,110	1,969	4,032		
Mica { Sheet.....	203,756	203,956	114,540	122,246	193,223
{ Scrap.....	11,940	15,250	13,330	26,178	37,237
Quartz.....	12,578	1,664			
Precious stones.....	5,000	7,580	570	479	700
Rare minerals.....		9,300			
Monazite.....	125,510	54,824	37,224	46,928	10,104
Zircon.....	248	46		250	
Barytes.....	10,030	18,855			
Talc and pyrophyllite.....	66,979	74,347	51,443	77,983	69,805
Mineral waters.....	31,413	40,302	27,163	20,558	21,389
Graphite.....	475				
Coal.....					
Stone.....	854,301	956,919	824,927	850,807	920,077
Sand and gravel.....	9,191	2,191	2,070	13,358	13,406
Sand-lime brick.....	32,975	38,803			
Kaolin.....	90,036	85,505			
Clay products.....	1,182,660	1,316,303	944,317	1,302,611	1,223,704
Miscellaneous.....			103,880	133,642	145,314
Total value.....	\$ 3,007,601	\$ 3,173,722	\$ 2,307,116	\$ 2,783,826	\$ 2,848,446

The following minerals and ores have been mined in North Carolina during the past three years and are taken up in this report in the order given: Gold and Silver; Copper; Iron; Tin; Abrasive Materials (including Garnet and Millstones); Mica; Quartz (Flint); Barytes; Monazite and Zircon; Talc and Soapstone; Precious Stones; Mineral Waters; Graphite, Coal; Peat; Stone (including Granite, Sandstone, Marble, and Limestone); Sand and Gravel; Sand-lime Brick; Kaolin and Clay Products.

GOLD AND SILVER.**

In the Mining Industry for 1906 a rather extensive report was made on the gold and silver deposits of the State, and, in the Mining Industry for 1907, some further details were given.

Some of the gold produced in North Carolina is obtained from placer deposits and some as a by-product in monazite mining; but the greater portion is obtained from deep mining.

Mr. H. D. McCaskey in his report† for 1908 gives the following review of the gold and silver mining industry in North Carolina by counties:

Anson, Ashe, Buncombe Counties.—There was no production in 1908 reported from Anson, Ashe, and Buncombe counties.

Burke County.—In Burke County there was a small production of placer gold from several operators. The surface veins and gravels of the Mills mine were worked by the hydraulic method and produced both gold and crude monazite.

* Included under "Miscellaneous."

** See also Bulls. 3 and 10, and Economic Papers, No. 14, pp. 19-70, and No. 15, pp. 12-19.

† Advance chapter from Mineral Resources of the United States, 1903, on Gold, Silver, Copper, Lead, and Zinc in the Eastern States, pp. 23-26.

Cabarrus County.—In Cabarrus County the Linker mine was idle in 1908, but there were a number of other producers, notably the Meadow Creek and New Nugget placer mines, from which a considerable production of gold, partly in nuggets, was obtained. There was also a small output of gold and silver, resulting from the working of the old dumps of the Phoenix mine.

Caldwell County.—From Caldwell County there was no production reported in 1908.

Catawba County.—In Catawba County the England, Peach Tree and Shuford mines all produced small outputs of gold and silver during the year. The Catawba Gold Mining Company, operating the Shuford mine, continued trials of machinery preparatory to the erection of a plant for treatment at a low cost of surface ores. The method of handling will include cable tramway, clam-shell excavator, trommels, crushers, rolls, riffles, and blankets.

Cleveland County.—In Cleveland County there was a small recovery of placer gold by the Carolinas Monazite Company after the concentration of monazite sands.

Davidson County.—In Davidson County both the Silver Valley and the Silver Hill mines were idle in 1908. The latter mine is one of the oldest and deepest in the State, and, with the Silver Valley mine, 5 miles to the northeast, has furnished the chief supply of lead-zinc ores of North Carolina. The ores are gold and silver bearing galena and blends, with smaller quantities of pyrite and chalcopryite, and the country rock is of schist.* The gossan was worked in the early days only for gold. The Emmons and Cid mines, of the Hercules Gold and Copper Company, were also idle in 1908. The former has been a producer of copper ores in recent years, and the company will probably resume operations. The Welborn mine did not produce in 1908.

Davie County.—The Gray mine, near Statesville, in Davie County, was operated for a short time only during the year, and no production was reported. The ore is wholly refractory.

Franklin County.—In Franklin County the production from the Portis mine was small, work upon this property having been confined to prospecting and development.

Gaston County.—In Gaston County a small production resulted from the reworking of ore dumps of the old King's Mountain mine and from other surface operations.

Guilford County.—In Guilford County the Deep River, Fentress, Oak Hill, Palachian, and Pine Hill mines were also idle, but there was a small output from the Hudson mine, near High Point.

Jackson County.—There was no production reported from any of the gold and copper prospects in Jackson County in 1908, but there was some development work done at the Cullowhee copper mine, and a 30-ton smelter and a 10-ton lixiviation plant were reported in course of erection.

Macon County.—There was no production reported from Macon County. Some prospecting is, however, reported to have been in progress, which showed the presence of both gold and silver ores.

McDowell County.—In McDowell County there was a small output of placer gold.

Mecklenburg County.—There was but little activity among the many old mines and prospects of Mecklenburg County during the year. A considerable amount of prospecting was done by the Southern Placer Mining Company, and there was a small production from the Catawba River dredge, the Yellow Dog mine, and from ores of the St. Catherine-Rudisil group near Charlotte, which were sent to the Halle plant for trial; but the Capps, Frederick, Grier, Johnson, and Surface Hill mines were idle practically throughout the year.

Montgomery County.—A small quantity of placer gold, chiefly as nuggets, came from surface mines, but the main production of gold from Montgomery

*Kerr, W. C., and Hanna, George B., *Geology of North Carolina*, vol. II, Pt. II, North Carolina Geol. Survey, 1888, pp. 193-199.

County, and from North Carolina, was derived, as usual, from the Iola mine. This property, the second largest producer of gold in recent years of the Appalachian States, is near Candor, and along the line of strike of the Montgomery and Golconda veins. Although one of the newest mines in the State, having been worked for only about eight years, the production in gold from this mine is already considerably over \$300,000, a respectable showing in the Eastern States. The mine has been most recently described by Hafer* and Lyon.** The development has been mainly by 4 shafts and 5 levels, and the plant for treating the ore has been gradually increased until a 40-stamp mill, with concentrators and a 40-ton cyanide capacity, have been reached. The country rock has been described as a "greenstone of slaty character, probably a sheared andesite," by Lyon, and the vein from 2 to 6 feet wide seems to have been quartz at the surface, but a "slaty quartzite ore carrying some lime spar" in depth. The gold has been found free for the greater part in the vein, but the walls are impregnated with pyrite. The ore has been found in shoots and seems to have been particularly profitable near the surface, although Lyon states that in the two lowest levels, 255 and 327 feet deep, north and south from the No. 1 shaft, the richest ore in the mine has been found. The company recently underwent reorganization, but the output reported for 1908 was somewhat higher than in the two preceding years.

Moore County.—The Laufman mine and the properties of the Elise Mining Company, near Hemp, in Moore County, were not operated during 1908, and there was no production reported by the Argo Mining Company from their Nash County mines.

Orange County.—In Orange County, however, the Robertson mine, of the North State Mining Company, made a small output from the 10-stamp concentrating mill. The development work, begun in June, 1908, included a shaft 120 feet deep and 350 feet of drifts. The mill was only started up at the close of the year.

Person and Polk Counties.—In Person County little was done in the Durgy and other mines of the Virgilina mining district; and in Polk County the Red Springs and Weatherby mines were idle, the production being confined to a small quantity of placer gold.

Randolph County.—In Randolph County there was no production in 1908 from the Boson, Empire, Redding, or Southern Homestake mines. The latter property, though but slightly developed, was equipped with a 100-ton milling and cyaniding plant only to prove disappointing by reason of low-grade ores and insufficient development of large bodies of them. A shut down followed the failure of ores to pay for an expensive and apparently too hastily erected mill. The Scarlett copper mine has been practically closed since the fall in price of copper in 1907.

Rowan County.—In Rowan County the Gold Coin mine, of the Southern Mining Company, at Gold Hill, produced a small output of gold from the operation for two weeks of the 10-stamp concentrating mill. The main shaft is 180 feet deep, and about 700 feet of underground work was reported for 1908. The Park mine was shut down, and the well-known Union mines were closed. The Gold Hill mines were worked but a short time, pending reorganization of the company operating them, but produced some gold, silver, and copper.

Rutherford and Stanly Counties.—There was a small placer production in Rutherford County, and the Double Branch mine yielded a small output of gold from ore obtained in development work. In Stanly County, also, there was but a small placer production in 1908.

Swain County.—There was no output reported from the Everett mine of the North Carolina Copper Mining Company in Swain County during the year.

Union and Other Counties.—In Union County production was confined to

*Hafer, Claud, Notes on Mining in North Carolina: Min. World, vol. 28, 1903, pp. 332-333.

**Lyon, E. W., The Progress of Gold Mining in North Carolina: Eng. and Min. Jour., vol. 87, 1909, pp. 295-296.

a small output of gold from prospecting the Davis mine, near Matthews, operated by the Winona Mining Company. The Phifer mine, on the Price tract of the holdings of this company, and the Black, Brewer, Indian Trail, and Union Mining and Milling Company mines, were all idle in 1908. There was also no production reported from any of the mines or prospects in Warren, Watauga, Wilkes, and Yadkin counties during the year.

Mr. McCaskey, in his report for 1909*, reviews the production of gold and silver by counties, as follows:

Burke County.—In Burke County there was, as usual, a small placer production from several properties. The Mills hydraulic mine was again the most important producer.

Cabarrus County.—Six producers reported an output of gold in Cabarrus County in 1909, the largest production coming from the dumps of the old Miami (or Phoenix) mine, near Concord.

Catawba County.—In Catawba County the Catawba Gold Mining Company, operating the England and Shuford mines, produced gold and small quantities of silver in 1909.

Cleveland County.—There was a small placer output of gold from operations near Shelby, in Cleveland County, in 1909.

Franklin County.—The Portis mine, near Louisburg, produced a small quantity of surface gold in 1909.

Gaston County.—A nominal production of gold was reported from Gaston County for 1909.

McDowell County.—In McDowell County there was a nominal output of placer gold in 1909.

Mecklenburg County.—In Mecklenburg County the Southern and Surface Hill mines yielded small quantities of gold in 1909. The St. Catherine-Rudisil and many other mines of this county were idle.

Montgomery County.—In Montgomery County the Iola mine yielded a greatly decreased output of gold in 1909. * * * The company operating the Iola mine has been recently reorganized, and the plant is reported to have been remodeled and enlarged.

Nash County.—There was a nominal output of gold in 1909 from the Mann-Arrington mine in Nash County.

Randolph County.—In Randolph County the Ashboro mine yielded a nominal production of gold in 1909.

Rowan County.—There was a small output of surface gold from Rowan County in 1909, and a production of gold, silver, and copper, from ores mined at Gold Hill. The Southern mine is equipped with a 10-stamp mill and is developed by a 175-foot shaft. The Union Copper Mines Company shipped copper-gold ore and concentrates to smelters on the Atlantic seaboard in 1909.

The ore deposits of the important Gold Hill district have recently been studied and described in detail by Laney.†

Rutherford County.—There was a nominal production of placer gold from Rutherford County mines in 1909.

Stanly County.—In Stanly County a small output of placer gold was reported from Whitney in 1909.

Union County.—The Bonnie Doon mine, in Union County, near Indian Trail, made no production in 1909, but development work was done and experiments were made in the treatment of low-grade ores. The shaft is 200 feet deep, and the plant includes a slow-speed, 25-ton, Chilian amalgamation and concentration mill.

Yadkin County.—Development work was reported from the Gross and Dixon mines near Cana, in Yadkin County, in 1909, and plans were formed for the erection of a smelter.

*Advance chapter from Mineral Resources of the United States for the year 1909 on Gold, Silver, Copper, Lead, and Zinc in the Eastern States, pp. 12-14.

†Laney, F. B., The Gold Hill mining district of North Carolina: Bull. North Carolina Geol. and Econ. Survey No. 21, Raleigh, 1910.

A review of the gold and silver industry in North Carolina during 1910, by counties, is given below:

Burke County.—Practically all of the gold and silver from Burke County was obtained from placer deposits near Bridgewater and Brindletown, among the deposits worked being the old Mills Hydraulic mine where some attempt was made to mine on a large scale. Sluicing was only partially successful at this mine, even with expensive equipment, including a Canton Hughes pump and 2,400 feet of 8" and 6" pipe through which water was raised 650 feet. The surface material covered hard rock to a slight depth and hydraulic mining failed. Attempts were made to develop the Hedge and White bank mines with some success.

Cabarrus County.—The principal output from Cabarrus County was obtained from re-working the dumps of the old Phoenix or Miami mine.

Catawba County.—The Catawba or Shuford mine was worked in open cuts for a short while during 1910 by steam shovel, conveyors, and washers, and yielded considerable gold. The England mine also made a small output of gold.

Caldwell County.—There was no production of gold from this county during 1910, but the owners of Carey's Flatt mine in Caldwell County state that there is a prospect of working this mine during 1911. Mr. J. A. Dula, of Lenoir, writes that he has a mine five miles south of Lenoir, claiming 400 acres of rich placer. He expects to organize a company to work same.

Franklin County.—The Portis mine of Franklin County reported a small production which was the outcome of a demonstration plant for testing the values of the property. The plant showed 65 per cent per cubic yard of values in runs of 100 yards or more. Development work is about completed. A 2,000-yard aerial cable wire plant is expected to be put in operation during 1911, and later a gold dredge of 5,000 yards capacity.

Gaston County.—A small production of gold was reported from Gaston County during 1910, principally from the Kings Mountain and Burrell-Wells mines. The former yields a small production annually, largely from re-working the old dump, and the latter was worked only during the first part of the year, later being closed and its machinery sold.

Jackson County.—A slight production of gold and silver was reported from Jackson County, this being obtained in connection with a small amount of copper mining at the Cullowhee mine. The Cullowhee Mining and Reduction Company are the owners of this mine and expect to equip a large plant.

McDowell County.—A small output of placer gold was reported from McDowell County during 1910.

Mecklenburg County.—The principal output of gold from this county during 1910 was obtained by the Catawba River dredge near Charlotte. The Piedmont Placer Mining Company, of Mecklenburg County, report that they had some tests made on their gravel in 1910, which were very promising. They have a steam dredge, shovel, sluice boat, and machinery for pumping. The Surface Hill Mining and Milling Company report that they have recently purchased the Surface Hill mine and have begun preliminary work.

Montgomery County.—A considerable production of gold was made from the Iola mine near Candor, which has been the principal gold producing mine of the State for many years. Their mill and cyanide plant was completely destroyed by fire, however, during the latter part of 1910, and a letter from the owner in February, 1911, stated that they had just started the construction of a new plant. Their old plant consisted of a Lehigh-Fuller mill and cyanide equipment with Parroll agitating tanks and an Oliver vacuum filter. A production was also reported from the old Coggins and the Golconda mines. The old Coggins mine, after standing full of water for 28 years, was unwatered during 1910. The shaft was re-timbered and some cross-cutting and drifting were done during the latter part of the year. The plant includes a 10-foot, 40-ton Chilian mill with crusher, Pierce amalgamators and concentrators and they propose to deepen the mine from the 200 foot shaft.

Moore County.—The Elise mine of Moore County made no production during 1910, but hope to produce during 1911.

Nash County.—There was some slight activity at the Mann-Arrington mine during 1910, and some other prospects near Nashville were reported to show gold and copper ores of some promise. These new finds are all on farm land not far from the Portis mine and are known as the Braswell, Nelms, Williams, Strickland, and Griffin prospects.

Orange County.—The North State or Robertson mine did very little work during 1910. There is expected to be a reorganization of the controlling interests.

Person County.—The entire output of gold and silver obtained from Person County during 1910 came from the Durgy mine, which supplied siliceous copper ore to the Ducktown (Tennessee) smelters during 1910. The Duke mine was prospected in 1910.

Polk County.—The Double Branch Gold Mining Company actively developed their mine during 1910. They have a 10-stamp mill, and one

3-stamp mill, a 40 h. p. engine, with boilers, and a Blake crusher. They have sunk two shafts on Big Vein, 35 and 50 feet respectively, to the 200 foot level. Work was also being done on two other veins.

Randolph County.—Prospecting on the Scarlett mine near Asheboro yielded a small amount of gold and the Talbert property also produced on a small scale. The Southern Homestake mine did some development, showing two new parallel pay streaks 5 feet wide, composed of schistose ore, yielding \$12 and \$4.50 gold and silver values respectively. The company has a 100-ton cyanide plant with a Blake crusher, etc. Mr. George Crawford, of New York City, has leased the John Laughlin gold mine, located about two miles west of the Sawyer mine. He expects to install a mill and concentrate the sulphide ores. The ore deposit is a quartz porphyry and slaty quartzite, with some of the locally known "Indigo ore." Mr. E. W. Lyon, of Greensboro, states that there are two parallel ore deposits about 150 feet apart and that when he examined it in 1908 it was opened by three prospect shafts, of 15, 25, and 34 feet depth respectively, showing $3\frac{1}{2}$ to 7 feet in width. The average assay values were from \$3.48 to \$14.20 per ton, the ore carrying 2 to 3 per cent of sulphide of iron.

Rowan County.—The mines at Gold Hill, in Rowan County, made but a small output in 1910. Preparations are being made to unwater the 850-foot Randolph shaft of the Gold Hill property. At the Union Copper mine the No. 12 shaft, which develops the gold vein, with traces of copper, was sunk 100 feet to the 400-foot level. A gold vein was opened up on the 230-foot level and mill tests were made on the ore. From No. 7 shaft, which develops a copper vein, with traces of gold, a sample shipment of ore was made. Mr. John Q. Foreman, of Salisbury, who now owns the Drexler mine in Providence Township, reported that in 1910 he was blowing out the old mine preparatory to mining. He has a 30 h. p. boiler, with 14-inch pump. The Steele placer near Cleveland was a producer in 1910.

Rutherford County.—Mr. John F. Jones, of Blacksburg, S. C., states that he expects to do considerable development work during 1911 on his mine in Rutherford County.

Union County.—The Bonnie Doon mine near Indian Trail made a considerable output in 1910. This property is opened by a 170-foot shaft and ore was stoped in 1910 from both 120- and 170-foot levels. A considerable quantity of old dump material has also lately been sent through the mills. The plant includes a 10-foot, slow-speed, Lane mill, built in 1910, and provision is made both for amalgamation and concentration. The Winona Mining Company, of Matthews, Union County,

made no production during 1910, but state that they have a Huntington 5-foot mill with engine and boiler and a Ledgewood hoisting engine with boilers and pumps and expect to begin mining during 1911.

Wilkes County.—The Flint Knob mine of Wilkes County expects to continue development work during 1911.

Yadkin County.—The Gross and Dixon Gold Mining Company, of Nebraska, have a mine located near Cana, in Yadkin County, N. C. The property consists of 66 acres of mineral land. They have sunk three shafts. Shaft No. 1 is 100 feet deep, with about 400 feet of drifting; shaft No. 2 is 50 feet deep, and shaft No. 3 is 30 feet deep. They have erected a 5-stamp mill, including a tube mill, and complete cyanide plant of 50-ton capacity, assay and refining equipment, etc. Their method of treatment is by stamp mill, re-grinding by tube mill, and then by cyanidation.

PRODUCTION.

In the following table there is given the production of gold and silver, by counties, in 1907, 1908, 1909, and 1910, which will illustrate the distribution throughout the State.*

PRODUCTION OF GOLD AND SILVER IN 1907 AND 1908 BY COUNTIES.**

County	1907			1908		
	Gold	Silver	Total	Gold	Silver	Total
Burke.....	\$ 2,976	\$ 13	\$ 2,989	\$ 3,479	\$ 15	\$ 3,494
Buncombe.....				96		96
Cabarrus.....	1,521	1	1,522	12,231	44	12,275
Catawba.....	6,274	45	6,319	2,053	17	2,070
Cleveland.....				1,558	6	1,564
Davidson.....	386	109	495			
Franklin.....	1,186	2	1,188	109		108
Gaston.....	300		300	841	2	843
Granville.....	145	2,226	2,371			
Guilford.....	1,863		1,863	64	1	65
McDowell.....	222	1	223	348	1	349
Mecklenburg.....	7,744		7,744	1,146	45	1,191
Montgomery.....	52,438	410	52,848	59,603	425	60,028
Moore.....	225	1	226			
Orange.....				295		295
Person.....	145	2,226	2,371	4,500	55	4,555
Polk.....				776	2	778
Randolph.....	300		300	83	4	87
Rowan.....	3,683	9,243	12,926	5,707	40	5,747
Rutherford.....	223	1	224	1,403	4	1,409
Stanly.....	50		50	1,033	5	1,038
Union.....	500	21	521	2,149	2	2,151
Unknown.....	2,014		2,014			
Total.....	\$ 82,195	\$ 14,299	\$ 96,494	\$ 97,495	\$ 668	\$ 98,163

*The gold and silver statistics have been obtained for 1907 principally through the Director of the Mint at Washington, D. C. The figures given for 1908, 1909 and 1910 have been estimates based upon figures obtained partly through the U. S. Assay office at Charlotte, N. C., and the collection of statistics by the State Survey. The counties given in these tables do not represent all the producing counties, but the production has been given, as far as possible, of the principal producing counties and the balance is given as "unknown."

**Coining value.

PRODUCTION OF GOLD AND SILVER IN 1909 AND 1910 BY COUNTIES.*

County	1909			1910		
	Gold	Silver	Total	Gold	Silver	Total
Burke.....	\$ 4,535	\$ 19	\$ 4,554	\$ 1,039	\$ 4	\$ 1,083
Cabarrus.....	1,838	8	1,846	228	1	229
Catawba.....	12,000	63	12,063	363	3	366
Cleveland.....	844	6	850			
Davie.....	1,466	14	1,510			
Franklin.....	29	10	39	1,039	2	1,041
Gaston.....	520	13	533	281	1	282
Granville.....	2,300	4	2,004			
Jackson.....	340	37	377	508	165	673
Lincoln.....	1,482	11	1,493			
McDowell.....	340	10	350	34		34
Mecklenburg.....	803	10	818	906	2	908
Montgomery.....	1,475	11	1,486	53,628	239	53,867
Moore.....				48		48
Nash.....	81		81			
Person.....				300	4,410	4,710
Randolph.....	1,476	11	1,487	3,856	17	3,873
Rowan.....	10,727	57	10,784	2,946	8	2,948
Rutherford.....	345	12	357			
Stanly.....	1,000	13	1,013	32		32
Union.....				3,364	36	3,400
Yadkin.....	800	12	812			
Unknown.....	939	6	945			
Total.....	\$ 43,075	\$ 324	\$ 43,399	\$ 68,586	\$ 4,888	\$ 73,474

*Coining value.

As will be seen from the above tables, Montgomery County led in the production of gold and silver during 1908 with a production of \$60,028; Rowan led in 1909 with a production of \$10,784; and Montgomery regained her lead in 1910 with a production of \$53,867.

The next table gives the value of the gold and silver produced in North Carolina from 1882 to 1910, inclusive.

GOLD AND SILVER PRODUCTION IN NORTH CAROLINA
FROM 1882 TO 1910.*

Year	Gold	Silver	Total
1882.....	\$ 190,000	\$ 25,000	\$ 215,000
1883.....	167,000	3,000	170,000
1884.....	157,000	3,500	160,500
1885.....	152,000	3,000	155,000
1886.....	175,000	3,000	178,000
1887.....	225,000	5,000	230,000
1888.....	136,000	3,500	139,500
1889.....	145,000	3,878	148,878
1890.....	118,500	7,757	126,257
1891.....	95,000	6,465	101,465
1892.....	78,560	12,671	91,231
1893.....	53,800	17,325	70,925
1894.....	46,594	455	47,049
1895.....	54,200	520	54,720
1896.....	44,330	646	44,946
1897.....	34,000	388	34,988
1898.....	84,000	905	84,905
1899.....	34,500	388	34,888
1900.....	44,653	15,986	60,639
1901.....	60,410	34,023	94,433
1902.....	93,650	30,212	123,862
1903.....	113,604	16,907	130,511
1904.....	123,924	19,133	143,057
1905.....	129,153	20,216	149,369
1906.....	122,003	30,944	152,952
1907.....	82,195	14,299	96,404
1908.....	97,495	608	98,163
1909.....	43,075	324	43,399
1910.....	68,586	4,888	73,474

*Coining value.

COPPER.*

Two reports have recently been issued by the North Carolina Geological and Economic Survey relating to the copper deposits of the State, one as Bulletin No. 21 on the Gold Hill mining district, by Dr. F. B. Laney, and Bulletin No. 22, a report on the Cid mining district of Davidson County, by Dr. Joseph E. Pogue, Jr. There is now in preparation a report, to be published in coöperation with the Virginia Geological Survey, on the Virgilina Copper District, which will practically complete a series of reports covering the copper deposits of the State. Owing to the low price of copper most of the copper mines have made small or no productions during the past few years. There is given below a brief description of the Virgilina District, prepared by Dr. F. B. Laney, who has made the field investigations on the whole Virgilina District of both North Carolina and Virginia for the North Carolina Geological and Economic Survey under the supervision of the two State Geologists.

THE COPPER ORES OF THE VIRGILINA DISTRICT OF NORTH CAROLINA AND VIRGINIA.†

BY FRANCIS B. LANEY.

INTRODUCTION.

The copper ores of the Virgilina district consist almost wholly of bornite and chalcocite. The level of ground water is from 50 to 75 feet below the surface and the zone of secondary alterations does not appear to extend below 250 feet. The important mines of the district are from 350 to 500 feet deep and the ore from the deepest levels contains almost as much chalcocite as bornite. If a specimen from the upper levels of almost any of the mines be examined in detail it is found to consist of the two minerals in such relations that no hesitancy is felt in pronouncing the chalcocite secondary and younger than the bornite. If, however, the specimen be taken from the deeper levels the two minerals are seen to be so intricately intergrown that no other conclusion than that they are genetically contemporaneous seems possible. These facts led some observers, notably L. C. Graton‡, to suppose that chalcocite occurs in these mines as a primary mineral. Chalcocite has been almost universally regarded as a mineral of secondary origin, *i. e.*, derived from some leaner copper-bearing sulphide. Its manner of occurrence as heretofore

*See also Bulls. 21 and 22, and Economic Papers, No. 6, pp. 20-25, and No. 15, pp. 20-55.

†Economic Geology, Vol. VI, No. 4, pp. 399-411.

‡U. S. Geol. Survey, Min. Res. 1907, Pt. I, p. 620.

observed left little doubt as to its secondary nature and there grew up a belief that the mineral is always secondary. The chalcocite of the Virgilina district therefore appeared to offer an exception to this generally accepted conclusion, and, with the hope of throwing some light upon the genesis of this mineral, a detailed microscopical examination of these ores was undertaken.

The field work upon which this investigation is based was done while the writer was employed by the Geological Surveys of North Carolina and Virginia and a detailed report on the geology of the district is now being prepared. This report will be published as a coöperative report by the North Carolina Geological and Economic Survey and the Virginia Geological Survey. This is probably the first time that a report covering a geological area embraced by two states has been published on such a coöperative basis by the two states.

GEOGRAPHY AND GEOLOGY.

Before entering upon a description of the ores a brief sketch of the geology of the district will be given.

Location.—The Virgilina copper district is located near the eastern border of the Piedmont Plateau in Person and Granville counties, North Carolina, and Halifax and Charlotte counties, Virginia, each State including approximately one-half of the ore-bearing area. It takes its name from the village of Virgilina, a station on the Southern Railway situated on the State line near the center of the district, and about 160 miles west of Norfolk and 45 miles east of Danville. The most important ore deposits occur on two approximately parallel flat-topped, though somewhat conspicuous, ridges which trend from 15 to 20° east of north, and which have very gradual slopes. The maximum elevation is at Virgilina, 540 feet above sea level. The relief is not pronounced, varying from about 300 feet up to the maximum above stated, but the country is decidedly hilly. Rainfall is rather heavy, especially during the winter and spring, and streams are numerous.

Geology.—The rocks of the district are highly schistose, and are popularly known as slates. They are of two distinct types, greenstone schists, and quartzose sericitic schists or gneisses. Into these schistose rocks have been intruded large areas of granite, and less important masses of more basic material, probably gabbro. Also here and there throughout the area occur small diabase dikes. The intrusive rocks are not schistose, and, were it not for the numerous joints which cut them, they would be perfectly massive.

A close examination of these schists readily reveals their true character—a great series of volcano-sedimentary rocks of two types: a decidedly basic rock, andesite; and one highly acid in character, a quartz porphyry. Of the andesite there are three types: porphyritic, amygdaloidal, and tuffaceous; and of the quartz porphyry only two—porphyritic and tuffaceous. Closely associated with the greenstone schists and grading directly into them are heavy beds of highly schistose greenish rocks differing from the tuffaceous portions of the andesite only in that they contain varying amounts of land waste intermixed with the basic volcanic material. These range from fairly well-marked sandstone and fine conglomerate on the one hand, to typical andesitic tuffs entirely free from terrigenous material on the other. The relative position of these two phases of the greenstone indicates that at the beginning of the volcanic activity there was a period when the volcanic material was not equal to the land waste, and thus were deposited beds of sandstone and conglomerate with only a small amount of ash from the volcanoes. As the activity increased, the amount of land material grew proportionately less and less, until at the time of maximum vulcanism it became nil, and the normal volcanic beds were formed. As this activity began to diminish the former conditions commenced to reassert themselves, and the beds deposited consisted to a greater or less extent of land waste.

The andesite and andesitic tuff pass by regular gradation into the sandy and conglomerate rock, so that in the field where exposures are the best it is not possible to draw a sharp boundary line between the two.

It is possible that the sandy beds may have been formed from the rapid erosion of unconsolidated volcanic ash beds as well as by the commingling of similar material with land waste at the time of eruption. Thus in either case it is clear that with an increase of the volcanic material the resulting rock would more nearly approach the true basic tuffs, while with a decrease of this it would approximate more nearly a normal sediment—a conglomerate, sandstone, or shale as the case might be.

The andesite and the andesitic tuff, especially the former, are the most massive of the older rocks of the region. The andesite is of two types, porphyritic, and amygdaloidal, both being much mashed and decidedly schistose. The amygdaloidal phase is not abundant, and is usually so highly metamorphosed that it is easily confused with the tuffaceous phase. All the ore deposits thus far developed, and in fact all the prospects as far as known at present, with a very few exceptions, are located in the andesite or the andesitic tuff.

The quartz porphyry is, for the most part, especially on the western

side of the area, a typical rock of its kind, but much mashed and highly schistose. The phenocrysts are largely of feldspar, with a variable and usually an inferior amount of quartz. The basal and the upper, and at times other portions of this rock, are to a greater or less extent tuffaceous. This is especially true of the eastern area, where by far the greater portion is probably a very fine tuff. No workable ore deposits have been found in this rock.

The age of these rocks is unknown; they have generally been regarded as pre-Cambrian. They appear to be somewhat similar to tuffaceous rocks intimately associated with the slate deposits lying northeast of the Virgilina district. These slates have recently been described by Watson* and Powell and shown to be early Paleozoic. It is believed that further study may determine the volcano-sedimentary rocks of this district to be of the same age.

The granite.—This is the youngest intrusive rock of the district except the diabase dikes, and is also the most important. Three prominent areas of it are included within the district, one in the southwest corner near Mill Creek postoffice, North Carolina, and another in the east-central portion at and surrounding Buffalo Lithia Springs, and the third and largest one, northwest of Red Oak postoffice, Virginia. This area of granite extends almost across the region of volcano-sedimentary rocks and cuts out the ore-bearing horizon for a distance of four or five miles. It is apparently massive, and therefore shows nothing of the prominent schistosity of the other rocks. In all the occurrences it is a rather coarsely granular, highly quartzose rock, and at times, especially at Buffalo Lithia Springs, it is decidedly porphyritic. Like all the other granites of the southeastern United States it contains a large amount of plagioclase in proportion to the orthoclase, and shows well its quartz-monzonitic character. This rock is of especial interest in that all the field evidence obtainable points toward the conclusion that it is the source of the ores, and that they and the veins are closely connected genetically with its intrusion. In this relation it is further considered in the paragraphs relative to the origin of the ores.

THE VEINS AND ORES.

The veins.—The veins are of quartz with locally a considerable amount of epidote and calcite. In width they vary from small stringers not more than a few inches up to 15 or 20 feet. They always have well-defined walls, and are probably true fissure veins. As is always the case with such veins, these present many irregularities, most prominent of

*Fossil evidence of the age of the Virgilina Piedmont slates, Thos. L. Watson and S. L. Powell, Amer. Jour. Sci., Ser. IV, Vol. 31 (1911), pp. 33-44.

which are the numerous pinches and swells, both linearly and vertically. At times they are reduced to little more than a mere stringer of quartz between two well-marked walls, while again they may locally swell out to more than twice their average thickness. In length they range from a few hundred yards to four or even five miles, and in many instances may be traced these distances by actual outcrop or by abundant quartz debris in the soil. Vertically they are also continuous, and aside from the irregularities in width, they are as well-defined in the bottom of the deepest shafts as at the surface. The size of the vein and the prominence of the outcrop form no criteria as to the richness of the mineralization. Often the richest ore bodies have been found under a very insignificant outcrop, and as often the strongest exposure at the surface is barren or very lean. The average strike of the veins is more northerly than the schistosity of rocks in which they occur, and while at times they follow the schistosity for short distances, their average strike intersects it at acute angles. The fractures in which the veins have formed are, therefore, regarded as having been made subsequent to the development of the schistosity in the country rock. The ore is not evenly distributed throughout the veins, but is concentrated locally into definite ore shoots. These present the usual irregularities and as a rule appear to have a slight southerly pitch in the vein.

The ores.—Though apparently preferring the quartz, the ore is so intimately associated with all the gangue material as to make it almost certain that all were deposited contemporaneously. The copper-bearing minerals are bornite and chalcocite with the oxidized products derived from them. Chalcopyrite is present in such small and varying amounts that unless careful search is made it will not be found at all, and it is apparently no more abundant in one portion of a mine than in another. Certainly there is no increase with depth in the amount of this mineral. In fact the mine which shows it most abundantly is only about 150 feet deep, and here it was as abundant in the first sulphides encountered as in those in the bottom of the shaft. In two of the deepest mines, the Holloway, 450 feet in depth, and the Durgy, about 400 feet, it is so rare that one can hardly find it.

Chalcocite occurs in two very distinct relations with the bornite, secondary to and filling fractures in the bornite, and intergrown, sometimes clearly crystallographically, with it. Bornite is the most important mineral in all the mines in the district except the Holloway, in which it is subordinate to chalcocite. It appears, too, from even a casual observation of the ores that there has been considerable shattering since their original deposition. This is especially prominent in the

ore from the Seaboard mine which furnishes the purest bornite in the district. In the fractures in the bornite from this mine, be they ever so minute, are developed veinlets of chalcocite, which penetrate the bornite in all directions, and vary in size from the finest line, often not visible to the unaided eye, but perfectly clear under the microscope, up to areas a quarter of an inch in diameter. In the center of many of these chalcocite-filled fractures are films of quartz which evidently mark the original fracture in which the chalcocite began to develop, thus showing that at the beginning of, or prior to the development of the chalcocite, there were solutions carrying considerable quartz. In the interior of some of the largest quartz veinlets thus formed there occur particles of chalcocite so related to each other as to indicate a growth of the quartz since the beginning of the deposition of the secondary chalcocite. Also in a few instances the vein of chalcocite when deeply etched, presents a kind of spongy skeleton of quartz appearing as if quartz and chalcocite were deposited simultaneously. The boundary between these veinlets of chalcocite and the bornite is exceedingly irregular, usually presenting a somewhat feathery outline, though always perfectly distinct and clear-cut. There is absolutely no gradation of one into the other. There is certainly a growth of the chalcocite, but how it takes place is not made clear by the microscopic study of the veinlets. It appears, however, that it takes place at the periphery of the already-deposited material, but the chemistry of the process has not been worked out. Where fractures of two periods are present they are both often filled with chalcocite, that in the younger fractures cutting across the veinlets in the older ones. Fractures also occur in the intergrown chalcocite and bornite, and in such instances the secondary veinlets cut across both the primary chalcocite and the bornite. The relation of the two minerals to each other in the case in hand leaves no doubt as to the secondary nature of the chalcocite. This type of chalcocite, as far as observations have extended, is confined to the upper portions of the veins and was not found in sections of ore from the deeper mines. It was found, however, in the upper portions of all mines from which sections were examined, and in many instances a single section would show excellent examples of both types of chalcocite.

The other type of ore is entirely different. Both minerals are present in every section examined, sometimes the bornite predominating, and at others the chalcocite. They are intimately associated with each other, but each has its own definite boundaries, cleavage, and other physical properties, with absolutely no indications that one is secondary to or derived from the other. In a number of sections the chalcocite predom-

inated over the bornite, and in such instances the indications seemed to be that the bornite was the first to crystallize. It occurs in irregular areas, sometimes separated and again connected, lying in a larger area of chalcocite. In other instances the two are present in approximately equal amounts, and there is nothing to indicate that one is older than the other. In other occurrences, as in the ore from the Blue Wing mine, the two minerals are present as small areas or grains and in approximately equal proportions. In these sections the appearance is as if a sponge of bornite while growing had been merged with another similar sponge of chalcocite, the association being so intimate and so complex that there is no way of accounting for it except on the basis of contemporaneous deposition. In the case of the sections in which the bornite appears to have been formed earlier than the chalcocite, it seems as though when the ores were being deposited the solutions were first saturated, as it were, for bornite, and this mineral began to crystallize out, the iron possibly being the determining factor. This continued until by a reduction of the bornite molecules in the solution the eutectic point for both bornite and chalcocite was reached, and these two minerals crystallized out simultaneously, and at times were intergrown crystallographically. The chalcocite is rather coarsely crystalline, and the etch figures show that the larger areas are made up of numerous interlocking grains, which stand out distinctly and have no definite crystallographic relation to each other. The cleavage, as brought out by the etching, is apparently in two directions at right angles to each other, one more prominent than the other, one possibly prismatic and the other basal.

The crystallographic intergrowths are the most interesting and also the most conclusive as to the contemporaneous deposition of the two minerals. These are by no means rare, having been found more or less perfectly developed in ore from all the mines except the Seaboard. At a magnification of 40 diameters these areas resemble very closely the intergrowths of quartz and feldspar in a micropegmatite. At the highest magnification used, 220 diameters, this resemblance is even more pronounced. In these intergrowths the minerals present perfectly sharp and clear-cut boundaries, with absolutely no indication of gradation of one into the other—boundaries just as sharp as between any minerals in an igneous rock. When an area of such intergrowth was etched deeply enough to bring out the two cleavages distinctly the chalcocite proved to be a single grain or crystal, the cleavage lines of which could be seen extending from one side of the grain to the other, interrupted here and there by the filaments of bornite. This type of texture among

minerals is possible only when they crystallize at the eutectic point of a solution, and it is, therefore, conclusive proof that in the case in hand bornite and chalcocite were deposited contemporaneously.

It is realized that while these minerals are contemporaneous, they both may be secondary after some leaner copper mineral. There are certain reasons for suspecting such conditions, the most prominent of which is probably the long period of erosion which the region had undergone since the ore deposits were formed. This long erosional interval would afford time for conditions of oxidation and enrichment to penetrate to exceptional depths in the ore bodies. With this idea in mind careful observations were made as to the depth of the zone of alteration as far as the same could be determined, and the conclusion is that it rarely if ever extends below 175 or 200 feet. The reason for its not extending to greater depths is the fact that the veins are so tight. They and their walls are all exceedingly dense and impervious to water, and the mines all furnish a surprisingly small amount of water, of which by far the greater part comes from the upper 100 feet of the vein. As an example of the tightness of the vein it may be mentioned that when the Blue Wing mine was unwatered about two years ago, it was found that the air pressure had held the water out of an upraise which had been started from the 266-foot level. The vein rocks were so tight that the air could not escape even though it was under a pressure of about eight atmospheres. Under such conditions as these, circulation of meteoric waters must necessarily be at a minimum. This tightness of the vein is characteristic of practically all the ore deposits of the Piedmont and Southern Appalachian regions.

The relations of ore to the gangue, and of the gangue minerals to each other are strong evidence against the assumption that the two sulphides are secondary minerals. It has been stated before that the ore is so complexly and intricately associated with the gangue minerals that no other conclusion than that of contemporaneous deposition seems tenable.

The minerals of the deposits, both gangue and ores, as a group, with the possible exception of the chalcocite, if they can be said to be characteristic of any one portion of a mineral vein, would probably be typical of the deeper vein zone.* These are, so far as has been determined, quartz, calcite, epidote, chlorite, specularite, bornite, chalcocite, a very little chalcopyrite, albite, probably orthoclase, and a lime-bearing plagioclase. It must be stated that feldspar of any kind in direct associa-

*Lindgren, Waldemar—Relation of ore deposition to physical conditions, *Economic Geology*, Vol. 2 (1907), pp. 105-107.

Emmons, W. H.—A genetic classification of minerals, *Economic Geology*, Vol. 3 (1903), pp. 611-627.

tion with the sulphides is rare, but good examples were found at the Seaboard mine, where the feldspar is a plagioclase, probably albite; at the Holloway mine where both plagioclase and a pink feldspar which is apparently orthoclase, occur, and at the Copper King mine where the feldspar is a lime-bearing plagioclase. Feldspars, however, are very abundant in many of the veins, especially in lean or barren portions. In such occurrences the mineral is generally albite or an acid oligoclase. In certain portions of the veins at the gold mine near Red Bank, Virginia, and Holloway mine in North Carolina, pink feldspar occurs in association with quartz so as to strikingly resemble a pegmatite. This is generally not closely associated with the ore, but at times, especially in the Holloway mine, it carries a small amount of the sulphides. It usually is found in barren portions of the vein or as stringers running off from the vein into the country rock.

Origin of the ores.—The origin of these ores is a more difficult question than one might at first suspect, and is as important as difficult. The country rock is by far too basic to have afforded the vast amount of quartz in the veins. Neither can the underlying quartz porphyry be looked to as the source, since this rock is also older than the veins and is itself cut by numerous quartz veins similar in all respects to those in the andesite and andesitic tuff except that they contain but little or no calcite and epidote and probably no copper ores. Some source, therefore, outside of and much younger than the country rocks must be looked for. The only rock in the region which apparently meets the conditions is the granite. This granite is highly quartzose, younger than the rocks in which the ore deposits occur, not intruded until after a strong schistosity had been imposed upon the andesitic rocks, and is a type of magma the intrusion of which is nearly always attended by more or less mineralization in the intruded or adjacent rocks. It is also well able to furnish the acidic material of the veins, and in its effects upon the intruded rocks through hydrothermal metamorphism, could very well have been responsible for the development of the calcite, epidote, and probably the chlorite. In fact it appears to be the only rock in the region that could have furnished the feldspars of the veins, or have been responsible for the pegmatite-like character of certain portions of some of the veins. It is, therefore, believed that the dynamic metamorphism attendant upon the intrusion of the granite, produced the fractures in which the veins now are, and that the filling of these, both gangue and ores, was supplied by the granitic magma, and that it came in as a phenomenon attendant upon or immediately following the intrusion.

As to the conditions of the deposition, there is little or no very positive evidence. Since the ore deposits are confined to the more basic facies of the schists, it may be surmised that the basic character of the rock was a factor of prime importance in the deposition of the ores.

SUMMARY AND CONCLUSIONS.

The rocks of the Virgilina district are greenstone and sericitic schists which in places have been intruded by granite and gabbro. The intrusive rocks show none of the schistosity of the other rocks. The schists have been derived from a series of volcano-sedimentary rocks of two types—andesite and quartz porphyry, with a preponderating amount of tuffs corresponding to these rock types. Their age is probably early Paleozoic.

The veins are tryo fissure veins, which have a more northerly trend than the schistosity of the country rock, and the filling of which is quartz—about 70% silica—with local and varying amounts of epidote and calcite. The ore-bearing veins are confined to the more basic portions of the greenstone schists, and the values lie in well-defined ore shoots.

The ores are bornite and chalcocite. They apparently prefer the quartz, but are not confined to any one of the gangue minerals. Bornite is present in slight excess over chalcocite and is apparently of only one period of deposition. Chalcocite is clearly of two periods: one confined to the upper portions of the vein, younger than and filling a network of minute fractures in the bornite; the other contemporaneous and intergrown often crystallographically with it. There is no evidence that any of the bornite is of secondary origin. It is, therefore, clear that in the Virgilina district the greater part of the chalcocite is a primary mineral contemporaneous with the bornite and in no way derived from it, or any other copper mineral, by processes of secondary alteration.

PRODUCTION.

During 1908, 1909, and 1910 the Blue Wing and Copper King mines of the Virgilina district, in Granville County, were idle.

Jackson County.—During 1908 there was reported some development work done at the Cullowhee Copper mine in Jackson County and a 30-ton smelter and 10-ton lixiviation plant were reported in course of erection. A production was made from this mine in 1909 and also 1910. The mine is developed by a vertical shaft 177 feet deep and by a 4,000-foot tunnel, and is equipped with a plant including a 40-ton water-jacketed Allis-Chalmers copper furnace. In 1910 the company reported that they expected to equip a larger plant still for handling their ores.

Person County.—The Durgy mine of Person County reported a small production of copper ore during 1910, but not sold on account of the low price of copper. During the year 1910 they opened a 400-foot level from the 500-foot level and started stopes between the third and fourth levels.

Rowan County.—A small production was made by the Union Copper mine of Gold Hill, and during 1910 they sunk 100 feet of shaft and made about 100 feet of lateral development. The Salisbury Copper Company, of Rowan County, reported that nothing was done in 1910, but there were prospects of further development in 1911. The Gold Hill Consolidated Company, of Rowan County, made a small production during 1910 and state that the outlook for future development is good.

In the table below there is given the production of copper ore, amount of copper obtained from this, and its value for the years 1900 to 1910, inclusive.

PRODUCTION OF COPPER FROM 1900 TO 1910, INCLUSIVE.

Year	Crude Ore Mined	Copper Produced	Value
	<i>Tons</i>	<i>Pounds</i>	
1900.....	6,948		\$ 41,600
1901.....	10,398	512,606	76,900
1902.....	16,741	1,417,020	212,563
1903.....	4,106	458,133	67,037
1904.....	4,250	305,000	36,000
1905.....	10,000	488,888	88,000
1906.....	11,729	703,775	135,829
1907.....	11,011	597,878	116,416
1908.....	180	19,393	2,560
1909.....	3,575	224,512	29,186
1910.....	2,221	140,514	17,845

As will be seen from the above table there has been a pretty steady decrease in the production of copper since the year 1907, due to the low price of copper ore.

IRON.*

North Carolina contains enormous deposits of iron ore, but they represent future sources of supply. There are but few of the iron ore deposits in the State which are capable of being developed and operated at the present time owing to the low price of pig iron and the distance of the ores from the furnaces and from sources of supply of fuel and flux.

The Cranberry mine of Mitchell County, however, contains two bodies of magnetite from which is produced a pig iron of exceptional quality which commands a higher price than ordinary pig iron.

*See also Bull. 1 of the N. C. Geol. Survey.

Recently there was much discussion as to the control of the iron ores of the United States by corporations, and the State Geologist was called upon by the *Manufacturers' Record* to make an estimate of the iron ores in North Carolina not controlled by such interests. Below is given an estimate of what is termed "present supply." By this is meant a supply under prices that existed eight years ago when it was possible to work some of the ores which cannot now be worked on account of the low price of iron.

Magnetite	6,650,000 tons.
Titanic magnetite	1,510,000 "
Hematite	250,000 "
Limonite	725,000 "

Below is given an estimate of what may be termed "future supply" of iron ores, by which is meant ores that can be worked when the price of pig iron and other conditions are such as to warrant it. In this estimate an arbitrary depth of 100 feet has been taken, but nothing below this.

Magnetite	8,975,000 tons.
Titanic magnetite	1,300,000 "
Hematite	900,000 "
Limonite	5,000,000 "

PRODUCTION.

In the table below there is given the production of iron in North Carolina from 1900 to 1910, inclusive.

PRODUCTION OF IRON ORE IN NORTH
CAROLINA, 1900-1910 INCLUSIVE.

Year	Amount Long Tons	Value
1900.....	21,000	\$ 42,000
1901.....	2,578	4,997
1902.....	34,336	52,771
1903.....	82,851	78,540
1904.....	64,347	79,846
1905.....	56,282	70,352
1906.....	56,057	75,638
1907.....	75,638	113,488
1908.....	48,522	76,877
1909.....	61,150	107,013
1910.....	65,278	114,237

TIN.*

During the past three years there has been no production of tin from the deposits of this metal in North Carolina, although there has been a certain amount of development work carried on at the deposits owned by the Piedmont Tin Company near Lincolnton, Lincoln County.

*See also Bull. 19 of the N. C. Geol. Survey.

ABRASIVE MATERIALS.*

During the past three years the production of abrasives has been confined entirely to a small production of garnet and millstones. The corundum deposits have not been worked at all. Practically all the corundum now used in the United States is imported, and comes mainly from Canada, in pulverized form, and the emery from Greece and Turkey.

Garnet is being mined by Mr. N. N. Rogers at Shooting Creek, Clay County, who has large quantities of this material.

PRODUCTION.

In the table below there is given the production of abrasive materials in North Carolina, including garnet and millstones, from 1901 to 1910, inclusive.

PRODUCTION OF ABRASIVE MATERIALS, 1901-1910 INCLUSIVE.

Year	Corundum		Garnet		Millstones		Total Value
	Quantity	Value	Quantity	Value	Quantity	Value	
	<i>Tons</i>		<i>Tons</i>		<i>Pairs</i>		
1901.....	325	\$ 48,840	775	\$ 43,000	50	1,425	\$ 91,840
1902.....			260	10,010	63	902	11,465
1903.....			**403	12,250	208	6,500	13,152
1904.....			**202	6,586	196	2,652	13,036
1905.....	†1,150	9,000			205	4,100	11,652
1906.....							4,100
1907.....							\$15,469
1908.....						4,052	4,052
1909†.....						9,188	9,188
1910†.....						7,981	7,981

MICA.††

Among the many varieties of mica only two are considered of economic importance because of their physical properties; *i. e.*, muscovite and phlogopite. Of these two varieties muscovite alone is found in quantities of commercial importance in North Carolina. Small quantities of biotite mica (black mica) have been used for commercial purposes within the last few years, however, and another variety, the lepidolite, has been used as a source of lithium salts. Chemically, muscovite is a silicate of aluminum and potash with a small amount of water; phlogopite is a silicate of magnesium, aluminum and potassium; and biotite is a silicate of magnesium, iron, aluminum, and potassium. The three micas are very similar in physical properties except color. In

*See also Bull. 11, and Vol. I, of the N. C. Geol. Survey.

**Including production of corundum.

†Including production of garnet.

‡Including corundum, garnet and millstones.

††See also Economic Papers, No. 6, pp. 40-47; No. 9, pp. 26-35; No. 14, pp. 82-103.

thin sheets muscovite is nearly colorless and is frequently called "white" mica; phlogopite is generally yellow or brownish and is called "amber" mica; biotite is dark brown to black, approaching black even in thin sheets. Each of these varieties of mica has strongly developed cleavage, so that it may be split into very thin, highly flexible, and elastic sheets. These properties of flexibility and elasticity, together with its toughness, transparency, and non-conductivity of heat and electricity, render mica, and especially muscovite, which possesses these qualities in a high degree, particularly useful for industrial purposes. The sheets can be trimmed and bent into a variety of forms according to the use required of them.

Below is given a report* on the Mica Deposits of North Carolina, written by Mr. Douglas B. Sterrett, of the United States Geological Survey. This supplements a similar report made by Mr. Sterrett and published in Economic Paper No. 14 of the North Carolina Geological and Economic Survey.

MICA DEPOSITS OF NORTH CAROLINA.

BY DOUGLAS B. STERRETT.

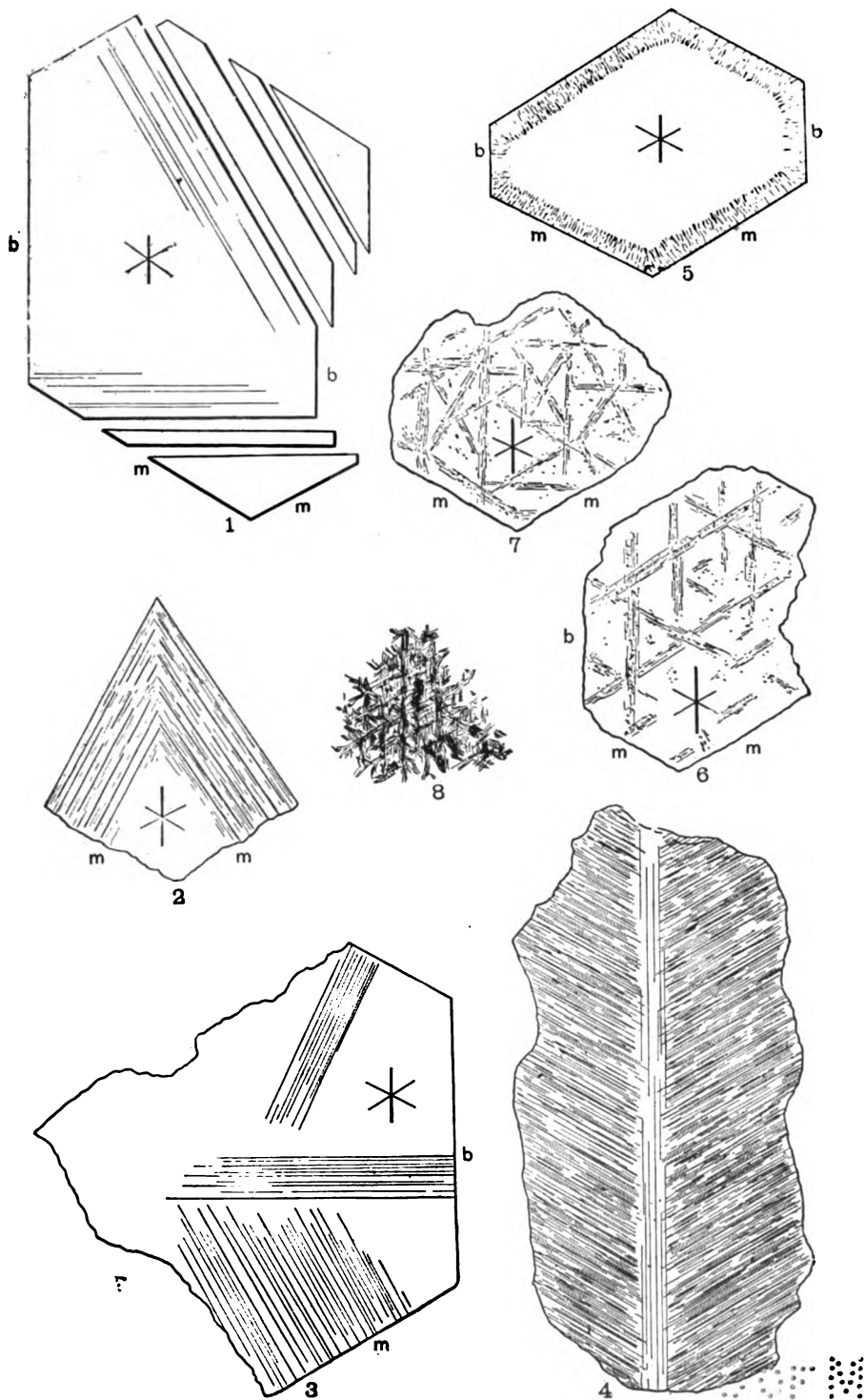
Mica is used in various industries, such as the manufacture of electrical machinery, stoves, certain forms of lamp chimneys, fireproof materials, wall papers, lubricants, etc. The perfect insulating qualities of mica and the adaptability of its sheets to various forms of manufacture render it unsurpassed for use in electrical apparatus. By fitting together and cementing with shellac many small thin sheets, mica is built up into large sheets of "micanite" or "mica board," suitable for many forms of electrical insulation. The transparency, flexibility, and resistance to heat of mica are qualities that make it particularly suitable for use in stove windows and lamp chimneys. When ground, mica is used to impart a silvery luster to wall paper and for other decorative effects. Ground mica is also mixed with oils and grease for lubricating purposes. When mixed with shellac, ground mica is used in various types of electrical insulators under the term "molded mica."

The information for the present paper has been obtained at various times during the last five years in the course of work for both the United States Geological Survey and the North Carolina Geological Survey. The greater part of the mine descriptions were obtained during 1905, 1906, and 1907 and represents typical deposits in all those counties in which mica mines have been examined by the writer. A large number of other descriptions have been prepared also, which it is hoped will be used in a later report by the State Survey. The brief notes on the general geology of the region and on the mica deposits are largely taken from an earlier paper,† in which the occurrence of mica-bearing pegmatites and their origin were treated, rather than commercial mines.

A number of the mica deposits of North Carolina were opened in prehistoric times by aborigines. Some of these operations have been described in the early days of mica mining by white people, and several of the deposits where such work was done, are described below. The present period of mica mining was begun in 1867 by L. E. Persons, of Philadelphia, previously of Vermont. Mr. Person's attention was directed to Jackson County by some-

*U. S. Geological Survey, Bulletin 430-J, advance chapter from Contributions to Economic Geology, 1909.

†Mica deposits of western North Carolina: Bull. U. S. Geol. Survey No. 315, 1907, pp. 400-422.



SPECIMENS OF MICA OF VARIOUS STRUCTURE.

4701

one in Philadelphia who had seen a crystal of mica exhibited at the State Fair in Columbia in 1858 by D. D. Davies, of Webster. In the fall of 1867 Mr. Persons went to Jackson County and learned from Mr. Davies the location of favorable prospects for mica in Jackson and Haywood counties, which he soon opened.* Shortly after this the mica industry began in Yancey and Mitchell counties with the opening of the Silvers mine by Thomas L. Clingman.

CHARACTERISTICS OF MICA.

Of the numerous varieties of mica there are but four that have commercial value. These are muscovite, phlogopite, biotite, and lepidolite. Muscovite and phlogopite have a wide application in both sheet and ground form. Biotite has only recently been used in the ground form. Lepidolite is used as a source of lithia salts and to a small extent for ornamental purposes. Muscovite is the only mica that has been mined extensively in North Carolina, and it is only within two years that a small demand has arisen for biotite for grinding.

Muscovite, like all the micas, belongs to the monoclinic system of crystallization and has a symmetry approximating the hexagonal. This symmetry is indicated by the nearly hexagonal outlines often observed in the prisms, by the percussion and pressure figures, and by "ruled" and "A" mica, as described below.

Mica mined for commercial purposes is generally found in rough blocks, sometimes with an irregular development of crystal faces. The faces are not usually as many as would be required to complete the simplest figure, and their surfaces are generally very rough. Very commonly a large part, if not all, of a block of mica has a ragged outline without plane surfaces. Occasionally fairly well developed hexagonal or rhombic prisms are observed in crystals of mica weighing hundreds of pounds.

Rough crystals, or "books" of mica, as they are called in the Western States, do not split perfectly until the outer shell of etched and sometimes partly crushed mica has been removed. This is accomplished by rough splitting or cleaving the large book into sheets one-eighth inch thick or less and trimming the edges with a knife held at a small angle with the cleavage. Further splitting is then easy, because the cleavage of mica is so perfect and the tangled outside edges of the sheets have been removed. By grinding a wedge edge on the sheets and using a thin sharp knife mica can be readily split into sheets as thin as one-thousandth of an inch or thinner.

A percussion figure is formed by three cracks or cleavages in a plate of mica crossing at a common point and making angles of approximately 60° with one another, commonly described as a six-rayed star. It may be produced by striking a sheet of mica a sharp blow with a pointed punch or thrusting the punch through the sheet. The same thing is produced occasionally on a large scale in a mine by a miner unintentionally striking the cleavage face of a block of mica with a pick. One of the rays, sometimes noticeably more prominent than the other two, corresponds in direction with the front axis of a mica crystal. The other two rays are parallel to the prism faces, *m*. (See Pl. I, *a* to *g*.)

A pressure figure is very similar in appearance to the percussion figure, but oriented with its rays at angles of about 30° with those of the percussion figure. The pressure figure is seldom obtained with the same symmetrical, perfect development as the percussion figure and is often very difficult to obtain. By pressing with a punch against a sheet of mica one or more rays of the pressure figure may be produced, and if the punch is then thrust through the sheet a percussion figure will also be formed and the two may be seen with their approximate 30° relation to each other.

Mica has a number of physical peculiarities which give rise to different trade names and descriptive terms used by the miners. These are due to crystal structure, color, and inclusions. Structural peculiarities give "ruled"

*This information was furnished by Judge D. D. Davies and Mrs. John L. Richardson, daughter of L. E. Persons, in a certified statement dated March 22, 1907.

or "ribbon," "wedge," "A," "hair-lined," "fishbone" or "herringbone," and "tangle-sheet" mica. Trade names for different colors of mica are "rum," "ruby," "amber," "white," and "black." Brown, green, and greenish-brown colors also occur in mica. Certain inclusions give "specked" and "clay-stained" mica.

"Ruled" or "ribbon" mica is formed by more or less clean, sharp parting planes cutting through the mica crystals and making an angle of a little more than 66° with the base or cleavage surface. This parting passes entirely through some crystals and in others extends only part way across the face or does not cut through the entire thickness. (See Pl. I, a.) The trace of the ruling planes corresponds in direction to the rays of the pressure figure in mica. Though a cleavage resembling ruling may be produced by making a series of percussion figures along the line of one of the rays, it is evident that "ruling" planes do not correspond to the lines of weakness represented by the percussion figure, for the two make angles of about 30° with each other. On the other hand, the ruling planes fall in the same direction as the rays of the pressure figure and probably occur along the lines of weakness represented by them.

"Ruling" lines occur more commonly in one series of parallel lines in mica. In some specimens these parting planes are present in two or even three directions, and their traces on the cleavage planes make angles of about 60° with one another, dividing the mica sheets up into small triangular plates. The value of large blocks or crystals of mica, otherwise of excellent quality, is sometimes rendered small or practically nothing by the presence of many "ruled" lines.

In "wedge" mica the crystals are thicker on one side than on the other. The difference in thickness on opposite edges may be greater than half an inch, in some crystals 3 inches in diameter. This structure is due to an unequal development in the width of the laminae. Some of the laminae extend across the entire width of the crystal, but others do not, and generally they are not matched by similar laminae extending from the opposite edge. In this way a greater thickness is developed on one side of a mica crystal than on the other. It is not uncommon for wedge-shaped sheets of quartz to be included between the laminae of such crystals. The "wedge" structure is often associated with the "A" and "fishbone" structure.

In "A" mica there are two series of lines or striations crossing the sheets at angles of about 60° with each other, whence the term "A." (See Pl. I, b and c.) In some pieces these striations are caused by "wedge" structure developed in the mica crystals, with or without the presence of detached swordblade-like strips of mica replacing the sheets that have "wedged" out. In other specimens the striations are caused by small folds or crenulations in the sheets of mica. The "A" striations have the same orientation in the mica sheets as the "ruling" lines; that is, their position corresponds to the rays of the percussion figure. "Ruling" is sometimes present in "A" mica. Where the striations are caused by small folds the mica sometimes splits across them and the sheets have a commercial value, though not as high as perfect plates. Where the striations are due to the "wedging" out of sheets, only plates from between the "A" lines can be used commercially and the value of large crystals is thus materially affected.

In the "fishbone" or "herringbone" structure striations with or without "ruling" and apparently identical with the "A" lines of mica make angles of about 120° with each other and join along a center line or spine. This gives a structure resembling the skeleton of a fish, as shown in Plate I, d. The "fishbone" structure is probably caused by a twinning of two crystals of "A" mica, so that one set of striations in each fall together and the other two sets are inclined toward each other and meet at the twinning line. Mica with the 'fishbone' structure has no commercial value as sheet mica, but is used for scrap for grinding.

In "tangle-sheet" mica (a name little used) the laminae split well over a portion of their extent but tear when split in other parts. This is due, in some places, to the failure of certain laminae to form perfect sheets and the intergrowth of portions of one sheet with that lying next to it. Such im-

perfections sometimes extend through half an inch or more of the thickness of a crystal of mica. In this way an apparently sound crystal of mica is rendered of little value or worthless for sheet purposes.

The color words descriptive of mica are self-explanatory, except the "white" and "black" mica of commerce. In speaking of the color of mica the miners or dealers ordinarily consider the color of sheets a sixteenth of an inch or more in thickness. Such colors as "rum," "ruby," "green," etc., observed in the thicker sheets of mica, practically disappear when the mica is split into thin sheets for trade purposes. The mica is then called "white" mica to distinguish it from phlogopite or "amber" mica. By "black" mica is generally meant muscovite "specked" with magnetite, as described below, but in some cases dark-brown to black biotite is also called "black" mica. "Rum," "ruby," "green," and the lighter-colored micas make the best grades of "white" mica for the glazing trade. Dark brown and brownish-green mica has to be split much thinner than "rum" mica to gain the desired transparency and is therefore generally classed as "No. 2," even when flawless and clear.

Some muscovite shows color variations arranged in accordance with the crystal structure. These more commonly appear in zonal bands following the crystal outline. Thus, to one looking through the sheets there may appear a center of dark "rum" color with a fringe of light "rum" or yellow surrounding it and possessing a hexagonal or rhombic outline; or the center may be light colored and the border zone dark, as in Plate I, e. In some sheets there are alterations of bands of varying color. Such color variations generally entirely disappear when the mica is split into sheets of the thickness required by the trade.

The pleochroism of mica is strong and may be well observed in small crystals with prism planes sufficiently smooth to transmit light. It will be found that crystals of such mica viewed edgewise are far more transparent than sheets of the same thickness. The color is also quite different in these two views.

Muscovite containing inclusions between the laminae of spots of particles of different-colored minerals is called "specked" and sometimes also "black" mica. Magnetite is the most common inclusion between the laminae and occurs as black to brown dendritic tufts arranged in definite lines or patterns corresponding to the crystal structure of the mica or scattered irregularly through the sheets. These tufts of magnetite are very thin and rarely penetrate appreciable thicknesses of mica. The dark-brownish color of many of these spots is due to the translucency of the thin films of magnetic iron. The arrangement of the streaks of spots in the mica is in some cases parallel to the direction of the rays of the percussion figure (Pl. I, f) and in others apparently parallel to the rays of the pressure figure (Pl. I, g). Each spot owes its dendritic appearance to the arrangement of still smaller particles of magnetite in lines following in some cases at least, the rays of the percussion figure. (See Pl. I, h.) From these lines of particles other particles branch off at more or less definite angles. By decomposition the magnetite is sometimes partly or entirely altered to hematite or limonite and the "specks" become red or yellowish brown. In this way striking patterns in colors are produced, which gives rise to the name "hieroglyphic" mica and which were once thought to be the inscriptions of the aborigines.

In the zone of surface weathering, and principally within a few feet of the surface, mica crystals are sometimes "clay-stained." This is due to the working in of clayey solutions between the laminae. The solutions penetrate large areas of some crystals and work in between many of the laminae, greatly damaging the value of the mica.

"Specked" or "clay-stained" mica has little if any value in the glazing trade, though either can be used in electrical manufacture. Their application even in the latter industry is less extensive than that of clear or "white" mica. Mica with "specks" of magnetic iron is not satisfactory for insulation where electric currents of high potentiality are used, because the "specks" tend to weaken the insulating qualities by acting as lines of less resistance.

Occasionally crystals or sheets of biotite are included in the muscovite

crystals, or vice versa. In such a case the two micas generally occur in parallel intergrowths and have a common cleavage plane. Large crystals of muscovite sometimes inclose smaller ones with no definite orientation. The cleavage of the included crystal is generally inclined or at right angles to that of the host.

DISTRIBUTION OF DEPOSITS.

Mica deposits have been opened in 18 or more counties in Western North Carolina. The deposits occur in an area nearly 75 miles wide and 200 miles long, extending in a northeast and southwest direction through the State. (See fig. 1.) For convenience this area may be divided into three belts—the Cowee-Black Mountain belt, the Blue Ridge belt, and the Piedmont belt. The Cowee-Black Mountain belt extends nearly through the State, parallel

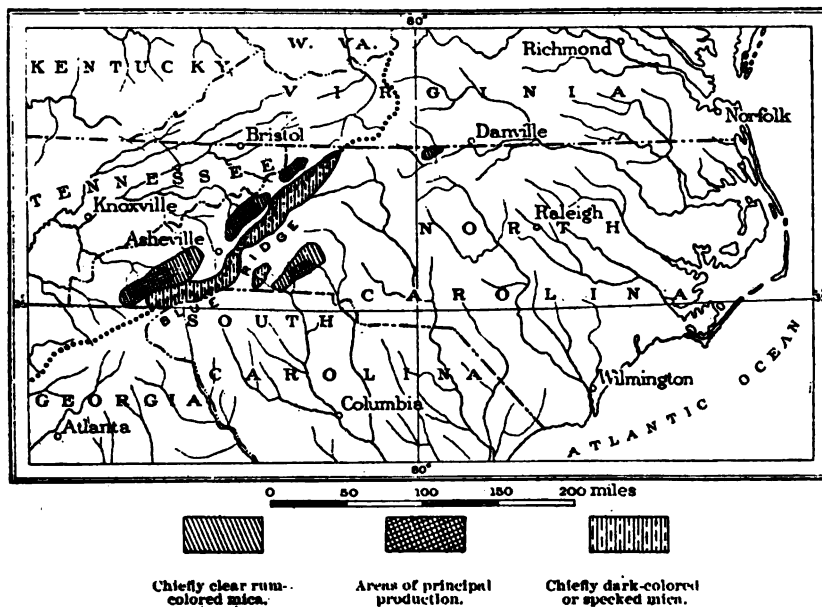


FIGURE 1.—Map showing areas in North Carolina in which mica has been mined.

to and near its northwest border. It lies northwest of the Blue Ridge and includes part of Macon, Jackson, Transylvania, Haywood, Buncombe, Yancey, Mitchell, Watauga, and Ashe counties. The Blue Ridge belt follows the Blue Ridge through the State and extends several miles to the southeast among the foothills. It is of small importance compared to the other two. Mines have been opened in Jackson, Transylvania, McDowell, Caldwell, and Wilkes counties in this belt. The Piedmont belt lies in the Piedmont Plateau and its small mountains, southeast of the Blue Ridge. Mica mines have been worked in Rutherford, Burke, Cleveland, Gaston, Lincoln, Catawba, and Stokes counties of this belt. Mica deposits of commercial value have not been found in unbroken succession in any of these belts.

The quality of mica obtained from different localities varies considerably, though in a single belt or in adjacent portions of the same belt the quality is commonly very similar. In general the mica of the Cowee-Black Mountain belt is clear and of a light color (as a rule "rum"). That from the Blue Ridge belt has a dark smoky-brown or greenish-brown color and much of it is more or less "speckled." In a large part of the Piedmont belt, especially in Cleveland, Gaston, and Lincoln counties, the mica is of good quality and similar to that of the Cowee-Black Mountain belt. There are exceptions

to these characteristics, in part connected with geologic conditions, such as the presence or absence of granite near by. Most of the mines described below are in the Cowee-Black Mountain belt. Exceptions are the Rochester mine in Jackson County, the Reed mine in Transylvania County, and the Triplett mine in Wilkes County, all in the Blue Ridge belt, and all the mines in Rutherford, Cleveland, Lincoln, and Stokes counties, in the Piedmont belt.

The Cowee-Black Mountain and the Blue Ridge mica belts are in the heart of the Appalachian Mountains. The deposits lie at various elevations between 1,500 feet above sea level and that of the highest mountains, or more than 6,500 feet. Some are high upon rugged slopes or summits where the soil covering is thin. Others are on the gentle slopes of valleys, or former plateau levels or terraces, covered by deep residual clays. Many of the deposits present ideal conditions for mine drainage. This is an important point, for the rainfall is excessive and the level of ground water is not deep. The deposits in the Piedmont belt occur in the low but locally steep ridges or in the few higher hills or mountains standing above the general level of the plateau. The plateau lies from 800 to 1,500 feet above the sea in the mica region and is more or less dissected by river and creek valleys 200 to 300 feet deep. The sky line seen from any prominent ridge is approximately level, with mountains or peaks rising above it at intervals. The problem of mining mica from deposits in the Piedmont belt is often difficult on account of their occurrence in hills with but slight elevation and gentle slopes so that natural drainage can not be readily secured.

GENERAL GEOLOGY.

The mica deposits of North Carolina have been found in highly metamorphic rocks, probably all of Archean age. These rocks are mica, garnet, cyanite, staurolite, hornblende, and granite gneisses and schists. Other rocks occurring in the region, also of Archean age, are granites, diorites, and peridotites, with their derived soapstones and serpentines. Younger granites, volcanic rocks, diabase, and sediments occur in parts of the region. The folding, faulting, mashing, and re-crystallization of the gneisses and schists have been so extreme that it is often difficult to determine the original igneous or sedimentary nature of the formations.

The major part of the mica deposits occur in two formations, as mapped by Keith*—the Carolina gneisses and the Roan Gneiss. The Carolina gneiss includes most of the gneisses and schists mentioned above that are not hornblende in composition. The Roan gneiss is composed of hornblende, gneiss and hornblende schist with smaller beds of mica gneiss and mica schist included. In the mica region by far the most important formation is the Carolina gneiss. This formation is also the oldest in the region and is intruded by younger igneous rocks, as hornblende gneiss and schist, peridotite, granite, granite gneiss, and diabase. Beginning with the Carolina gneiss the formations have been gashed and cut by the later igneous rocks into irregular-shaped masses, in many places forking out into long tongues or occurring as long, narrow streaks in the intrusives, or vice versa. The diabase rocks are probably of Triassic age and cut across the strike of the older formations in long, narrow dikes. The Carolina and Roan gneisses have been interbanded with and cut at all angles by numerous streaks of granitic or pegmatitic material. These range from a fraction of an inch upward in thickness and locally pass into mica-bearing pegmatites. In some places this pegmatization is so thorough that mica gneisses become strikingly like granite gneisses.

OCCURRENCE OF MICA.

Mica deposits of commercial value in this State are confined to pegmatites. These rocks vary considerably in form, some being typically lenticular in shape and others more or less persistent in length. The lens-shaped

*Cranberry (No. 90), Asheville (No. 116), Mount Mitchell (No. 124), Nantahala (No. 143), Pisgah (No. 147), and Roan Mountain (No. 151) folios, Geol. Atlas U. S., U. S. Geol. Survey.

bodies are generally conformable with the schistosity of the enclosing rock. They may lie in the same line of bedding or schistosity and be connected by smaller streaks or stringers of pegmatites, or by mere seams in the rock. Many of them, on the other hand, lie in planes of schistosity more or less separated from one another and form parallel or overlapping bodies. In cross section some of these lenses are short and bulky, with a length only two or three times the thickness; others are long and tapering and may constitute simply a bulge in a sheet of pegmatite. In many places the schistosity of the enclosing rock bends around the lenses.

Some of the more persistent pegmatites occupy straight fissures that hold their direction for a considerable distance. Elsewhere they are folded with the country rock or bent and twisted into various shapes. Many are more or less conformable with the bedding of the gneisses and schists. In that case they are in large measure subject to the deformations of the country rock. In many places, however, the pegmatites are conformable for some distance and then branch out, cutting from one layer to another across the bedding. Locally there is an elbowing or bulging out on one wall, without a similar irregularity on the other wall of the pegmatite. It is not uncommon for pegmatite masses to cut across the country rock for long distances.

Though pegmatites have been worked for mica in regions of hornblende gneiss and hornblende schist, where they are directly associated with those rocks, most of the deposits are found in small biotite gneiss or schist masses included in the hornblende areas. Where the pegmatite is in contact with hornblende gneiss, the latter may be highly biotitic.

Pegmatites occur in irregular masses, streaks, lenses, augen, or balls, some of them having no visible connection with other pegmatite bodies. They range from a fraction of an inch up to many yards in thickness. The limit of size below which they can not be profitably worked for mica might be placed arbitrarily at 1 to 2 feet for rich and regular "veins." In the very large pegmatites the mica is not, in general, evenly distributed through the mass, but is richer in one portion than another, so that the entire bulk of the rock does not have to be removed in mining. The irregularities of pegmatites and the consequent difficulties in mining mica from them are well illustrated in road cuts or similar excavations, where pegmatized gneiss or schist has been exposed. The lenticular shapes, pinching and swelling, crumpling, folding, and faulting to be observed in these cuts are found to be nearly duplicated in larger pegmatites opened for mica. As stated before, these smaller masses may grade into those containing mica of commercial value. Here and there the two can be seen at the same locality.

Horses, or inclusions of wall rock, are common in pegmatite. Some of them are in the form of bands or sheets parallel to the walls, and the schistosity of these bands is also parallel to the walls. They range from an inch or two up to several feet in thickness, and their length may be many times their width. Elsewhere they occur as irregularly shaped masses, from a few inches up to several feet thick. If the bedding has been preserved, it may lie at any angle with that of the enclosing wall rock. In some places the horses are partly pegmatized by streaks of pegmatite ramifying through them and by the development of considerable feldspar and quartz through their mass. In such places no sharp line can be drawn between the pegmatite and the original horse.

Pegmatite is closely allied to granite in composition. As in granite, the essential constituents are feldspar and quartz, with more or less mica and other accessory minerals. Though hornblende is rather a common mineral in granite, it is less so in pegmatite. Orthoclase and microcline are the most common varieties of feldspar found in pegmatite. In many places, however, a variety of plagioclase, either albite or oligoclase, makes up part or all of the feldspar component. The feldspar occurs in masses and rough crystals, some of them with a diameter of several feet.

Quartz assumes various forms and positions in the pegmatite. In many places it bears much the same relation to the feldspar and mica as in granite, the three minerals being thoroughly mixed with one another; but the

individual grains are many times larger than in ordinary granite. Not uncommonly the quartz and feldspar assume a graphic granite texture in a portion of the pegmatite. Another common feature is the occurrence of large separate masses of quartz occupying various positions in the pegmatite. Such quartz masses may be irregular in form and but little influenced by the shape of the pegmatite or inclosing wall. Many of them, however, lie in bands or sheets parallel to the walls. There may be one or more of these quartz bands constituting varying proportions of the pegmatite. Their thickness ranges from a fraction of an inch up to 6 or more feet. Many of them are lenticular in shape, the length varying from four or five to twenty or more times the thickness. In numerous places these quartz streaks or veins are persistent through the whole length of the pegmatite exposed. Some inclose feldspar or mica bodies; others do not. The quartz of these segregations is massive and generally granular, though locally crystallized. If crystallized it may be translucent or clear and of a dark, smoky or light color. It is generally rather pure and does not contain feldspar or mica in appreciable quantity.

Muscovite is the common mica of pegmatite and is the only variety mined in North Carolina. Biotite occurs in moderate quantity in a few deposits, and in smaller amounts in many others. Where muscovite and biotite occur together in a deposit, the muscovite is generally clear and of good color. Again, mica from deposits in rock formations where the ferromagnesian minerals are abundant, such as hornblendes or biotite gneiss and schist, is generally found to be clear and of light color. Where the pegmatite is closely associated with or occurs in granite with a paucity of the ferromagnesian minerals, the mica is generally of dark color and much of it is "specked."

The mica occupies various positions in the pegmatite. Where the rock has a typical granitic texture the mica may be found evenly distributed through it. More commonly the larger crystals will be found either in clusters at intervals through the "vein" in places connected by streaks of small crystals, or collected along one or both walls of the pegmatite, with some of the crystals partly embedded in the wall rock. Where there is a quartz streak within the pegmatite, the mica occurs on either or both sides of it. The mica may be partly embedded in the quartz or be scattered through the remaining portion of the pegmatite, which generally is composed largely of feldspar.

"Mica capping" is a miner's term for an aggregation of mica and quartz, with or without feldspar and other minerals, in which the mica is small or occurs in distorted crystals so as to be of small commercial value. The idea conveyed, that the mica forms a capping to a regular "vein" below or near by, is not necessarily true, for some such deposits carry nothing but "mica capping." The mica of "mica capping" commonly occurs in "wedge" shaped blocks with the "A" structure, in many places is more or less distorted or twisted, and may contain inclusions of quartz.

Aggregations consisting wholly or almost wholly of mica crystals occur in some of the pegmatites. Some of these masses measure several feet across. The crystals composing such massive mica range from a small fraction of an inch to 2 inches or more in diameter and thickness. Massive mica generally occurs in irregular shaped bodies without definite arrangement in the pegmatite.

A large number of minerals have been found associated with mica in pegmatite. Some of these have commercial value in manufacturing industries, or as gems and specimens. The feldspar associated with the mica deposits of North Carolina has not yet been used commercially, but the kaolin formed by its decomposition has been mined extensively. Some of the kaolin deposits are worked for that mineral alone, as they contain little if any merchantable mica. Numerous deposits that may prove of value for both mica and kaolin are known.

DESCRIPTION OF MINES.

MACON COUNTY.

Smith or Baird Mine.—The C. D. Smith mine is about a mile west of Franklin. It was worked on a large scale by aborigines, as described below. The mine was opened in the early days by C. D. Smith, and last in 1905 and 1906 by Mr. Eldridge, of Franklin. None of the operators were successful in finding large bodies of mica after the work of C. D. Smith. Some of the later workings cut through layers of scrap mica in old dumps and openings filled with rubbish. Some of this scrap mica was of sufficiently good quality for electrical uses. Several shafts were sunk near the old openings on the top of the ridge but failed to locate the "vein." One of the later tunnels from stream level encountered the filling material of ancient workings and could not be driven farther on account of the loose ground caving badly. About 75 yards northwest of the shafts, across a small branch, a small amount of work was done along a quartz ledge striking N. 60° W. The country rock at this mine is mica gneiss, containing more or less biotite and garnet, with a few diorite inclusions. The mica has a clear "rum" color and is of good quality. Considerable biotite is associated with the muscovite. A large sheet of mica measuring 16 by 18 inches is still kept in the Baird house near the mine as a specimen of the material obtained during the operations of C. D. Smith. The early operations at this mine have been well described by Mr. Smith, and his description is quoted below.*

"The ancient works on my own farm are the most extensive I have yet seen and are therefore worthy of description. The vein, as I have proved by my drifting upon it, has a general strike of N. 73° W., S. 73° E. So far, however, as I have drifted upon it, it runs in a zigzag along this general strike. The old excavation commenced at a small branch and runs at a right angle from it into a ridge that juts down with a gentle slope. The dump material has been thrown right and left for the first hundred feet. I tunneled in diagonally and struck the vein 60 feet from the branch, and have drifted along it 40 feet. Here we reach an immense dump rim, 65 feet higher than the level of the branch, and which seems to have been thrown back upon their works. It forms at this end a circular rim to the continued excavations higher up the ridge. The whole length of the excavation from the branch to the upper end of the cut is about 320 feet. The material removed from the upper part of the cut was carried up the hill as well as down it. The dump on the upper side of this upper part of the cut, and at the widest point, is about 25 feet above the bottom of the excavation, and at this point dump and excavation measure about 150 feet across. At the upper end of my tunnel the old digging has been carried down about 30 feet below the surface. If the excavation at the point just mentioned was carried as deep as the work of the upper end of the tunnel, it would make the dump heap on the upper side 55 feet higher than the bottom of the old works. I have been thus particular, in order to show that with mere stone implements it must have required a series of years and a large force to have accomplished such results."

Iotla Bridge Kaolin and Mica Mine.—The Iotla Bridge mine, 4 miles N. 10° W. of Franklin, has been worked for both kaolin and mica. The last work was by the Franklin Kaolin and Mica Company in 1907. The deposit lies in the hill along the west bank of Little Tennessee River, near the mouth of Iotla Creek. The developments consist of eight or ten tunnels, about the same number of shafts and pits, and two good-sized open cuts. The deepest shaft is 65 feet deep and was sunk from the summit of the hill, 120 feet higher than the lowest opening. Two other shafts were sunk to depths of 40 and 45 feet and connected with underground works. The workings extend over a distance of 550 feet, starting in a northwesterly direction at the south end, swinging to north and south along the hilltop, and ending with a northeasterly trend at the north end. The kaolin formation and country rock have the same sweeping curved trend. The country rock is mica gneiss with associated hornblende gneiss streaks.

*Smith, C. D., Ancient mica mine in North Carolina: Rept. Smithsonian Inst., 1876, pp. 441-443.

The pegmatite is irregularly conformable with the inclosing gneiss and may not be one body over the whole length of the developments. The thickness of the pegmatite body varies from a few feet to nearly 100 feet. In places the feldspar component was massive and has thoroughly decomposed, giving large masses of pure kaolin. In other places there is considerable mica and quartz mixed through the feldspar, and these still remain in the kaolin. Large bodies of sugar quartz were encountered in the workings and a large mass outcrops on the hilltop west of the shafts. Boulders of quartz are scattered over the hillside below part of the pegmatite outcrop and in the river along the west bank at the north end of the deposit. The greater part of the mica yield from this mine has been in small sizes. During 1907, however, one large crystal that weighed over 4,000 pounds was found in a small tunnel connecting with the 65-foot shaft. This crystal was somewhat irregular in shape, though possessing a rough rhombic outline. It measured about 29 by 36 inches and was about 4 feet thick. It was not sufficiently solid to yield sheets of this size, though much material 12 to 18 inches square was obtained. The block was sold in the rough for \$1,500. The quality of the mica from this mine is excellent and the color a rich "rum."

Chalk Hill Mine.—The Chalk Hill mine is $1\frac{1}{2}$ miles east of Burningtown. Operations have extended over a distance of 200 yards up the west side of a ridge to the top and for 150 yards down the east side. The principal workings with the deepest shafts are on the west side of the ridge considerably below the top. The country rock is interbedded hornblende and mica gneiss, with a strike of N. 80° E. and dip of 75° N. The main lead of the mica deposits is parallel with the schistosity of the country rock, though small streaks of pegmatite were observed cutting the strike of the gneiss. Outcrops of massive sugary quartz occur along the whole line of openings, and large bodies of it were cut in some of the workings. Two or more "veins" have been developed by the main lead of workings. Thirty yards south of the point where the main lead crossed the ridge another pegmatite streak carrying mica was exposed in a cut. The mica from this mine is clear and has a beautiful "rum" color. A little biotite is associated with it, and in some places the two are intergrown.

Burningtown or Poll Miller Mine.—The Burningtown mine, 3 miles S.

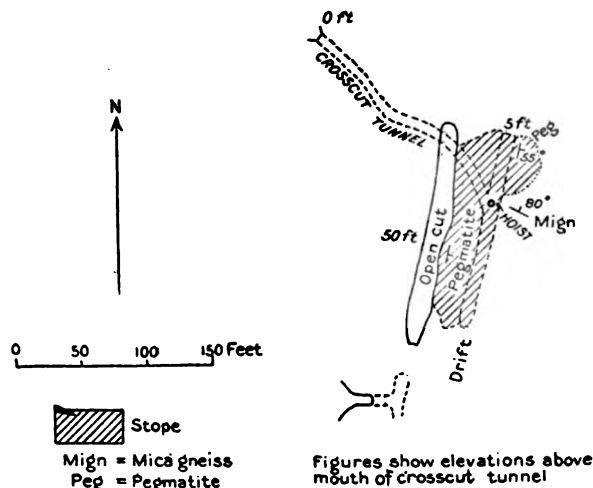


FIGURE 2.—Plan of Burningtown or Poll Miller mine, Macon County, N. C.

55° E. of Burningtown Bald, was opened before 1880. It was worked intermittently until 1903, and from then until early in 1906 on a larger scale by

the Flint Mica Company, of Flint, Mich. This company equipped the mine with electric-power drills, hoisting machinery, and lights. The power drills were discarded during the last year of operations and hand drills only employed. Electricity was generated by a dynamo and turbine using the fall of a neighboring stream. The workings consist of a large open cut, a crosscut tunnel with drifts and stopes, and a small prospect tunnel with short drifts on the level of the open cut. The drifts from the main crosscut tunnel are about 45 feet lower than the open cut. The "vein" has been removed above the drift by a large stope extending to the bottom of the open cut. An incline stope was also driven from the drift to a depth of 45 feet. A plan of the workings is shown in figure 2. A hoist was located in the drift at the end of the crosscut tunnel.

The country rock is mica gneiss with a strike of N. 70° W. to east and west and a dip of 80° N. The pegmatite cuts across the country rock with a strike of N. 10° E. and a dip of 55° E. It varies from 6 to 12 feet in thickness and carries quartz streaks. One of these has a maximum thickness of 4 feet and is near the middle of the pegmatite. The mica yield is from the feldspar streaks between the quartz and mica gneiss walls. The quality of the mica from the Burningtown mine is excellent and the color a clear "rum." The production is said to have been large while the mine was in operation.

Hall and Welch Mines.—The Hall and Welch mines are on opposite sides of the same ridge, 5 miles N. 60° W. of Franklin, and may well be described together. The relative position of the two mines with a plan of the work-

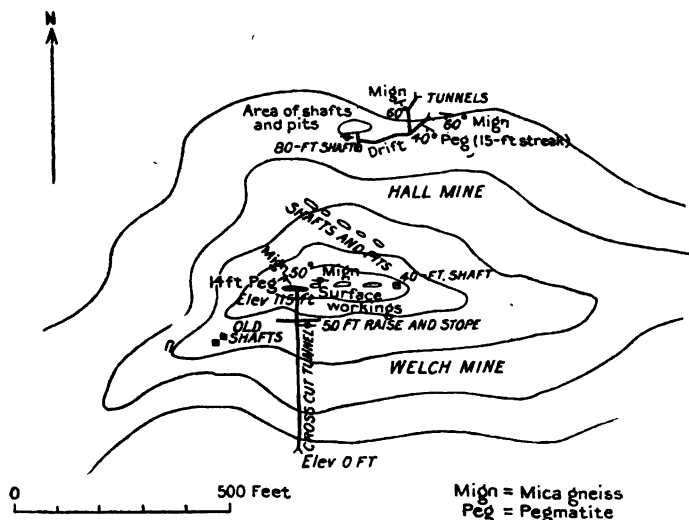


FIGURE 3.—Plan of Hall and Welch mines, Macon County, N. C.

ings and details of the geology, is shown in figure 3. At the Hall mine the tunnels on the northeast were started nearly at stream level and were carried in as crosscuts and drifts on the "veins" to the bottom of a shaft 80 feet deep. From a higher level in this shaft a crosscut leads to extensive workings on the north. These workings and the shaft have partly fallen in. Farther up hill a line of pits and shafts shows the position of another "vein." Still farther south along the summit of the ridge is another line of outcrop workings with a shaft 40 feet deep at the east end. Openings have been made for a distance of nearly 250 yards along this lead and assume a southwesterly course farther west along the ridge. More than 120 yards to the south and 115 feet lower down the hill a new crosscut tunnel has

been driven in, cutting the "vein" that forms the crest of the ridge and another "vein" about 60 feet south of it. The latter "vein" is 2 to 3 feet thick and has also been prospected along the outcrop. Drifts have been run both east and west along this pegmatite, and a 50-foot raise with stope has been made on the east side of the crosscut tunnel. The pegmatite forming the crest of the ridge is about 14 feet thick where cut by the tunnel. Two quartz streaks from 1 to 3 feet thick are inclosed in the pegmatite parallel with its direction. This pegmatite body cuts across the mica gneiss country rock in part, with a varying east-west strike and nearly vertical dip. The mica yield has come chiefly from the two outside feldspar streaks between quartz and mica gneiss walls, but a small amount has been obtained between the two quartz streaks. The mica obtained from these mines is of fine quality, with a clear "rum" color.

Neal Bryson Mine.—The Neal Bryson mine is 1 mile south of West Mills, on the east side of Little Tennessee River. The mine is in a small depression in a steep hillside. In this depression the soil has accumulated to a depth of several feet and carries mica from the breaking down of former pegmatite bodies. A small amount of "groundhog" mining has been done in this soil and debris for its mica content. The principal workings consist of an old shaft with drifts and stopes on the vein, a new 180-foot crosscut tunnel, and a shaft with other drifts. The mouths of the shafts are about 60 feet above that of the crosscut tunnel. The old stopes from the old shaft extend down to the level of the new tunnel. The drift from this tunnel to the east connects with the new shaft on this level and on a small level 15 feet above. The position of the workings, with details of the formation, is shown in figure 4.

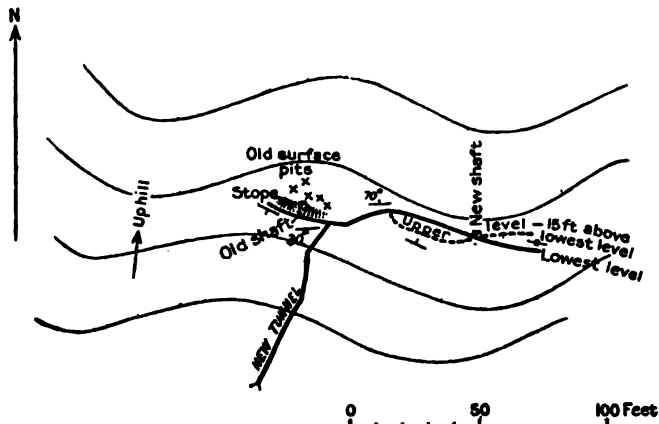


FIGURE 4.—Plan of Neal Bryson mine, Macon County, N. C.

The pegmatite has an irregular east-west strike, with varying dip that shows considerable warping. The dip ranges from vertical to 70° N. in one place and to 30° S. at the west end of the workings. The vein varies from one foot in thickness in one part of the workings to 12 feet in others. A quartz streak varying in thickness with the thickness of the pegmatite is included near the middle of the pegmatite where the latter is over 3 feet thick. The mica occurs in the feldspar between this quartz streak and the mica gneiss walls. At the east end of the tunnel the "vein" is richest next to the south wall. The quality of the mica from this mine is excellent.

Campbell or Higdon Mine.—The Campbell mine is about 1½ miles N. 75° W. of Cowee Gap, where the Webster-Franklin road crosses. Over a dozen tunnels have been run in on probably two or more "veins." The mine is in a shallow cove or hollow on a steep mountain side. The soil accumulation

in places in this cove is deep, especially over the lower part of the mine. This soil contains more or less sheet-mica debris from the disintegration of pegmatite veins. Mining through this soil is difficult, as land slides occur. One recent slip has taken place in the cove in which a large body of the soil has dropped down about 10 feet. This slip is evident on the surface above the workings. At the time of visit (1906) there were two tunnels open in hard-rock formation, an old one in slide material was being cleaned out, and another 250 feet long at the base of the old workings was being driven in search of "vein" matter. This tunnel was very crooked, because it was necessary to avoid loose slide rock in several places. In one of the hard-rock tunnels a good pegmatite "vein" about 10 feet thick, was encountered. It contained a 2- to 5-foot quartz streak within its mass. The yield of mica was from the partly kaolinized feldspar streaks between the quartz ledge and mica gneiss walls. The mine has yielded a quantity of fine quality of mica with a clear "rum" color.

Beasley Mine No. 1.—The Beasley mine No. 1, also called "Bradley butt," is one-half mile east of Mica City. It has been operated by a large open cut with a little stoping from its bottom and several tunnels at lower levels on the hillside. Some of these openings are on different "veins" from or branches of the main pegmatite worked in the open cut. The open cut is about 200 feet long and has a maximum depth of 30 feet. One of the tunnels below the cut was run in about 75 yards. The pegmatite was as much as 30 feet thick in one part of the open cut and pinched down into two small streaks 1 and 2 feet wide with 4 feet of mica gneiss between them at the east end of the cut. The country rock is biotite gneiss. The pegmatite strikes about east and west, with a dip of 85° S. near the outcrop and of 30° S. at a depth of 25 feet. The pegmatite cuts sharply across the gneiss and horses of gneiss are included within it. The rock formations are unaltered and very hard at this mine, requiring much blasting. Irregular segregations of massive quartz occur through the pegmatite. Portions of the feldspar have a greenish cast, caused by stains from the partial decomposition of a small amount of sulphides scattered through it. A large pocket of mica, yielding a quantity of large sheets of high grade mica, is reported to have been found in the open cut. Much of the mica from the Beasley No. 1 mine is of excellent quality, with a clear "rum" color, but some of greenish color with an "A" structure was found in one of the lower openings.

Beasley Mine No. 2.—The Beasley mine No. 2, is about one-half mile south of Beasley mine No. 1, on the south side of a high ridge. The deposit has been opened by prospect pits for about 150 yards along the outcrop and by a tunnel with drifts, large stopes, and an incline shaft connecting with the stopes. The lowest tunnel entering the drifts to the stopes is about 75 feet lower than the mouth of the incline entering the stopes on the hillside above. The drift from the end of the tunnel is about 150 feet long and the farther half of it opens up into the stope above. The country rock is mica gneiss, which has an east-west strike and a dip of 65° S. at the mouth of the tunnel. The pegmatite strikes about N. 70° W., with a dip of 40° SW. The pegmatite is more than 15 feet thick in places, but the entire thickness was not removed in mining. The mica evidently occurred more plentifully within the mass than along the walls. In 1906 these old works were being cleared out preparatory to developing new ground. The mica from this mine is of fine quality. A small amount of biotite is associated with it.

Winecoff Mine.—The Winecoff or old Jacobs mine is 2½ miles northwest of Franklin. It has been opened for a distance of about 300 yards, in a northwest-southeast direction, by numerous shafts, pits, cuts, and tunnels. A plan of the workings is given in figure 5. At 1 remains of ancient workings were found, and later four shafts with "groundhog" tunnels were made. The pegmatite has a width of about 25 feet where exposed in these openings and is badly decomposed. The principal developments to the northwest were made by the last owner, Mr. Winecoff, before 1907. At 2 a pegmatite ledge was exposed in an open cut varying in thickness from 5 feet at the surface to 8 feet in the bottom of the cut. At 3 a shaft 35 feet deep en-

countered a pegmatite ledge inclosing quartz bands. At 4 and 5 two shafts reported to be 65 feet deep exposed a pegmatite ledge varying from 2 to 8 feet in thickness and containing quartz bands. At 6 a shaft about 40 feet

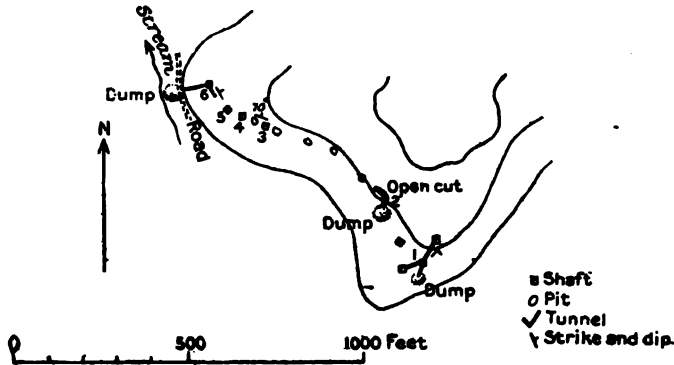


FIGURE 5.—Plan of Winecoff mine, Macon County, N. C.

deep connecting with a crosscut tunnel and drifts encountered a pegmatite composed of a 6-foot streak of quartz with small feldspar streaks along the sides.

The workings at 1 are probably on a different pegmatite body from those to the northwest, though it is possible that a swing in the strike (northwest) at 1 might bring the same pegmatite ledge to 2 and other points. The strike and dip of the pegmatite are shown by appropriate marks at 1, 3, and 6. The banded appearance of the "vein" is marked in openings 3 to 6 by streaks of quartz and mica schist, in the pegmatite and parallel with its walls. The principal field of mica has been from the workings at 1 and 4 to 6. Possibly the same pegmatite was opened at the old Harris or Raby mine, about 75 yards northwest of and across a branch from the Winecoff mine. The mica from each of these mines has a clear "rum" color and is of fine quality.

JACKSON COUNTY.

John Long Mine No. 1.—The John Long Mine No. 1 is one-fourth of a mile northeast of the mouth of Wayhutta Creek, 4 miles southeast of Web-

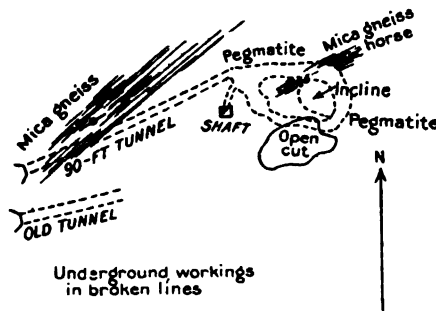


FIGURE 6.—Plan of John Long mine No. 1, Jackson County, N. C.

ster. It has been worked by a tunnel 90 feet long and nearly on the strike. At this distance the tunnel forks into two branches, which come together again about 45 feet farther on. Where the tunnels join, an incline working

was sunk under the large pillar left between them. There has been some open-cut work on the outcrop—a shaft which passed to one side of the underground workings and an old tunnel now caved in. The position of the workings is shown in figure 6, p. 45. The pegmatite formation has decomposed badly and is so soft that the tunnels require careful timbering. The greater part of the ground left between the branching tunnels is pegmatite, with the exception of a horse of mica gneiss several feet thick. The pegmatite contains quartz streaks or ledges lying parallel with its general course. Several large blocks of mica and many small ones were seen in the kaolinized feldspar. This mica was more or less fractured and contained a considerable quantity of clay stains between the laminae. The mica has a clear "rum" color where the crystals have not been clay stained.

John Long Mine No. 2.—The John Long mine No. 2 is at the mouth of Wayhutta Creek. The mine has been opened by a crosscut tunnel 60 feet long, driven from a point slightly above the creek level, with a 40-foot drift on the "vein." The latter has been stoped out to the surface for a distance of 20 feet and has been removed to a depth of 10 feet below the level of the tunnel. The country rock is biotite gneiss striking about N. 25° E. with a nearly vertical dip. The pegmatite is 10 to 12 feet thick and includes a number of streaks of gneiss. The mica occurs more plentifully along the east wall of the pegmatite and this portion is removed in mining to a width of 5 to 8 feet. The streaks of included gneiss split the pegmatite into lenses and bands from a few inches to a foot or two thick. The formation is fresh and hard from the surface down and requires much blasting. The mica is of fine clear "rum" color. It is reported that during three months of 1906 \$400 worth of rough mica was obtained.

Painter Mine.—The Painter mine is 2½ miles S. 65° E. of Sylva, on the northwest slope of a small mountain. The mine was opened many years ago by two shafts, with drifts, and a tunnel at a lower level but not connecting with the shafts. Later, more systematic operations resulted in a tunnel 175 feet long opening into a stope nearly 200 feet long. The stope was carried to a depth of 40 feet below the tunnel level and some 20 feet above, being very irregular in shape. A longitudinal section through the "vein" showing the shape of the workings is given in figure 7. The country rock is

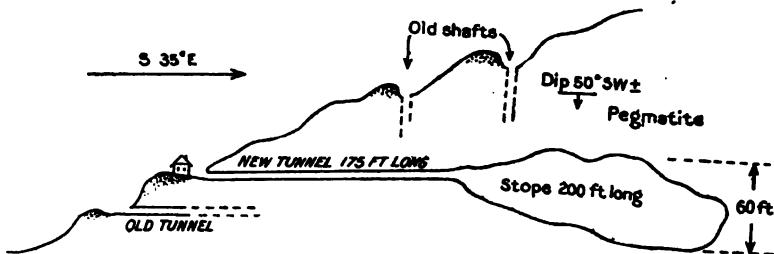


FIGURE 7.—Section in plane of the "vein" at the Painter mine, Jackson County, N. C.

garnetiferous mica gneiss which has a strike of N. 35° W. and a high dip to the southwest. The pegmatite is approximately conformable with the inclosing gneiss. The "vein" varies from 2 to more than 15 feet in thickness at the end of the stope. A large quartz streak in the middle of the pegmatite in this stope is left as a foot wall for the workings. The mica streak lies between this and the hanging wall. It is possible that more mica might be found by further prospecting the feldspar streak between the quartz streak and the foot wall. Several large blocks of mica were exposed in the face of the stope at the time of examination (1905). The mica is mostly clear and of good quality, though a small amount of "specked" material was seen on the dumps. A strip of "ruled" mica of fine clear "rum" color saved as a specimen at the mine measured 2 by 15 inches. It exhibited the "A" structure slightly at each end, but was perfectly sound in the middle.

The mine is equipped with a hoisting engine and pump at the mouth of the tunnel and a track in the tunnel and stope.

Piney Mountain Mine.—The Piney Mountain mine is 1 mile north of Sugarloaf Mountain, in the summit of a small knob. The mine has been worked by open cuts, crosscut tunnels, drifts, stopes, and shafts. The positions of these workings are shown in plan view in figure 8. Evidently work

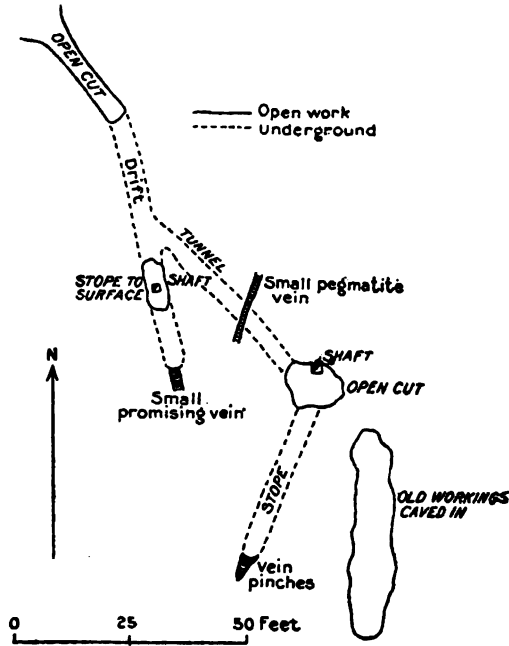


FIGURE 8.—Plan of Piney Mountain mine, Jackson County, N. C.

has been done on three separate "veins" with varying, nearly northerly strike and approximately vertical dips. The westerly "vein" was followed from the open cut by a drift with a stope to the surface and a shaft in the bottom of the open stope. At the end of the drift the pegmatite was only 2 feet thick, but it was still fairly rich in mica. An open cut with a shaft in the bottom was made on the middle vein and a stope driven southward from the cut. A crosscut tunnel was also run to the drift on the west "vein" for the easy removal of waste. The easterly "vein" was the first opened and the workings on it have fallen in badly. It is reported that the mica-bearing part was stoped out.

The country rock is mica gneiss. It is cut by small masses and streaks of pegmatite in various directions. The pegmatite worked for mica ranges from 1 to 12 feet in thickness. A quartz streak is generally present in the interior of the pegmatite and oriented parallel with its walls. This mine is reported to have been a good producer of mica.

Big Flint Mine.—The Big Flint Mine is about half a mile west of south of Wesner Bald and about 200 feet above one of the forks of Cabin Creek. The mine takes its name from the immense boulder-like mass of white quartz that marks its outcrop. Several "groundhog" pits and tunnels have been made under the quartz mass, to the west of it, and on the hillsides below it. Large masses of quartz outcrop in the branch about 100 yards east of the mine. The country rock is mica gneiss with an east-west strike and a dip to

the south. The "Big Flint" mass of quartz is about 40 feet across and at least 25 feet thick. It does not appear to have any connecting mass below, for excavations have been made under a large portion of it from each side and have encountered only kaolin and mica. The under side of this quartz mass is rounded and is composed of overlapping lenticular and shell-like masses of quartz from an inch or two to a foot thick. Fine partings of mica have developed in the seams between these lenses. The feldspar, entirely altered to kaolin, is massive under the quartz mass. This kaolin also shows lense-shaped layers with parting seams or slips about parallel with those in the quartz. In the openings west of the quartz mass the feldspar formation is massive and contains streaks rich in small mica crystals. A wall of mica gneiss exposed here, probably a horse, has a north-south strike and dips 45° E. The mica obtained from this mine is principally in small sizes, but is of light color and good quality.

Wayehutta Kaolin and Mica Mine.—The Wayehutta kaolin and mica mine is on the west side of Black Mountain, near the head of Wayehutta Creek and 3 miles due south of Willetts. The mine is 300 or 400 feet above the

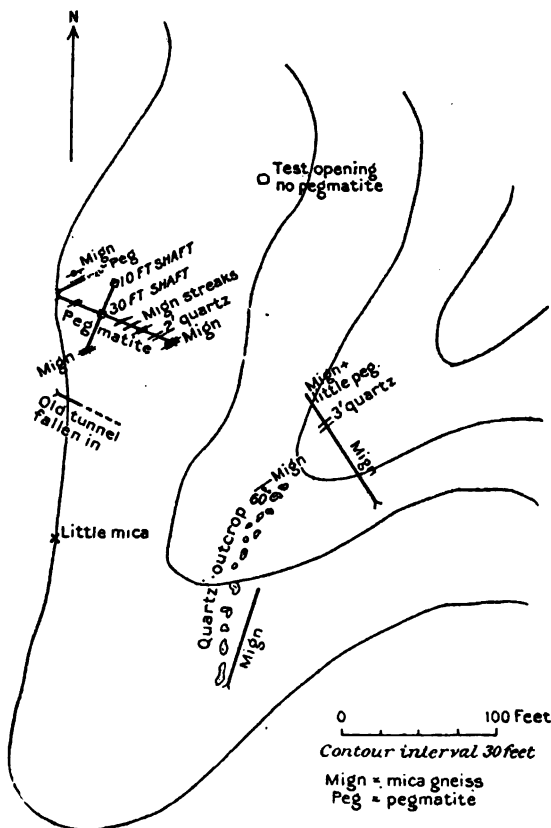


FIGURE 9.—Plan of Wayehutta kaolin and mica mine, Jackson County, N. C.

valley, on the side of a steep ridge, near and on the top. Developments consist of an 80-foot tunnel with 45 feet of crosscutting and two inferior shafts on the pegmatite, with several other trial tunnels and openings. The latter do not expose the main body of the pegmatite. Figure 9 shows the position

of the different openings and the formations encountered in each. The country rock is mica gneiss with a strike of N. 60° to 70° E. and a southeasterly to vertical dip. The pegmatite contains in places streaks or horses of mica gneiss, and its contact with the gneiss is highly irregular. A massive quartz vein 2 feet thick was encountered near the southeast side of the pegmatite. Another quartz ledge, 3 feet thick, outcrops on the top and opposite side of the ridge, 40 yards southeast of the kaolin deposit. Workings on this quartz ledge show that it is not directly connected with the main body of the pegmatite. The feldspar of the pegmatite is thoroughly decomposed and in places has altered to large masses of pure kaolin. The upper 12 feet of the 30-foot interior shaft and 9 feet of the 10-foot shaft were cut through kaolin. A small amount of clear "rum" colored mica was found in parts of the workings.

Cedar Cliff Mine.—The Cedar Cliff mine is one-fourth of a mile east of the Deep Gap of Black Mountain. The mine is located in the face of a cliff of hard rock. It has been operated by an open cut nearly 60 feet high and 5 to 25 feet back in the face of the cliff. The country rock is garnetiferous mica gneiss, striking N. 45° E. with a northwest dip. The pegmatite cuts across the gneiss with a strike of N. 10° E. and nearly vertical dip. The "vein" varies from 1 to 3 feet in thickness and contains streaks of quartz parallel with its walls. Other pegmatites outcrop in the cliff and some show indications of mica in commercial sizes. The mica is clear and of good quality.

Leon Hooper Mine.—The Hooper mine is on the road along Moses Creek, a little more than a mile above its mouth. It was worked by an open cut 60 feet long and 10 to 18 feet deep along the "vein" close to the roadside, and a crosscut tunnel under the road to remove waste. The country rock is mica gneiss, which strikes N. 50° E. with a dip of 75° SE. The pegmatite is conformable with the inclosing gneiss and has a thickness ranging from 5 to 12 feet. In the thicker portions the whole of the pegmatite was not removed, only that containing a "lead" of pockets in the interior being mined. The mica gneiss is very schistose near the contact with the pegmatite. The latter contains a few sheets of quartz lying parallel with its walls. One of these quartz streaks near the northeast end of the cut was 18 inches thick, pinching out in a distance of a few feet. The mica at this mine has a dark-brown color in sheets one-sixteenth of an inch or more thick, but is clear when split into thin sheets. Part of it is a little "specked."

The Pinhook Gap Mine.—The Pinhook Gap mine is on the southwest side of the gap of that name in Tennessee Ridge. This mine has been worked extensively at various times. During 1905 a new deposit was opened about 250 yards southwest of the old workings. C. H. Wolford operated the Pinhook Gap mine during part of 1905 and 1906. He reported a production of about 600 pounds a week of merchantable sheet mica during part of this time.

The older workings consist of a large open cut with a crosscut tunnel driven from its southwest corner a short distance out into the pegmatite, and thence turning along the strike of that rock. This connects with a tunnel driven in from the southwest at a lower level. Other short tunnels were driven from the open cut in various directions. Numerous pits and crosscut trenches were made a short distance to the northeast. The pegmatite is irregular in shape, swelling from a thickness of a few feet to the southwest to 30 feet in the open cut and nearly 50 feet northeast of it. Quartz segregations and streaks are scattered through it. On the east side of the open cut a mass of boss or garnet-mica rock or "mica capping" several feet across was encountered. It was composed of bunches of "wedge" shaped mica crystals showing the "A" structure, with coarse garnets scattered thickly through it. The mica crystals ranged from a fraction of an inch to 3 inches across and the garnets from small size to nearly 2 inches in diameter. The garnets constitute at least 25 per cent of the whole mass and are found to be fresh and firm on crushing, even if apparently badly weathered on the surface.

Operations at the later workings consist of a shaft 30 feet deep with a drift on the vein and a crosscut tunnel from the hillside below. The country rock is mica gneiss, which strikes N. 40° E. with a dip of 40° NW. The pegmatite is conformable or nearly so with the strike of the gneiss. The outcrop of the "vein" is marked by large masses of quartz. These quartz masses are irregular in shape and some of them pinch out at small depth. The feldspar part of the pegmatite is also irregular in shape. It is 6 feet thick at the surface in the shaft.

The mica from the Pinhook Gap mine has a brownish color and is partly "specked." Large-sized sheets are sometimes obtained, however, in which the "specks" can be eliminated by splitting.

Roda Kaolin and Mica Mine.—The Roda mine is on the south side of Tuckasee River opposite the mouth of Caney Fork. The deposit lies in the summit of a low rounded hill and has been proved on three sides by tunnels and pits. The relative position of these workings is shown in figure 10 (a). The deposit has a large outcrop of massive, coarse, sugary quartz over it, and this quartz was also encountered in the workings. The first work was for mica on the south side of the hill and in this the large mass of kaolin was exposed. The principal development is a crosscut tunnel on the west side. This cuts masses of both gritty and very good kaolin and sugar quartz. A 40-foot shaft was sunk from the interior of this tunnel and encountered kaolin through its whole depth. A diagram of this tunnel is shown in figure 10 (b). The tunnel on the east side of the deposit was driven 18 feet in a mass of fairly pure kaolin after passing through a number of feet of soil.

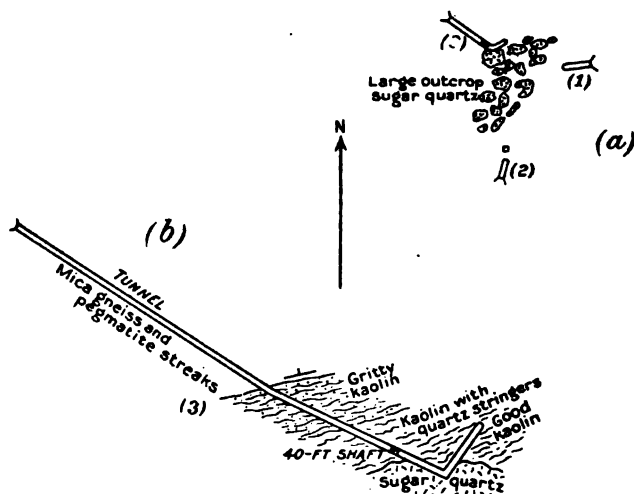


FIGURE 10.—Roda kaolin and mica mine, Jackson County, N. C. (a) Plan; (b) details of tunnel 3 shown in (a).

Jim Wood Mine.—The Jim Wood mine is on the west side of Wolf Creek, about a quarter of a mile above the Wolf Mountain road. It was worked by an open cut about 50 feet long and an open incline stope 20 feet deeper from its bottom. The country rock is mica gneiss with a layer of gritty talc schist a few feet southeast of the pegmatite. The latter is conformable with the inclosing gneiss and strikes N. 70° E. with a dip of 50° N. The "vein" was rich in mica near the surface for the whole length opened, but was sufficiently rich to work for a length of 8 feet only near the bottom of the incline. At the bottom of the incline the "pay streak" became longer again.

The whole thickness of the pegmatite was not removed, only that portion carrying the mica streak being mined. The workings and geologic relations are shown in cross and longitudinal sections in figure 11 (a) and (b). The mica has a dark-brown color in sheets of sufficient thickness, and part is "specked." Some of the crystals are well developed and others are partly "wedge" shaped.

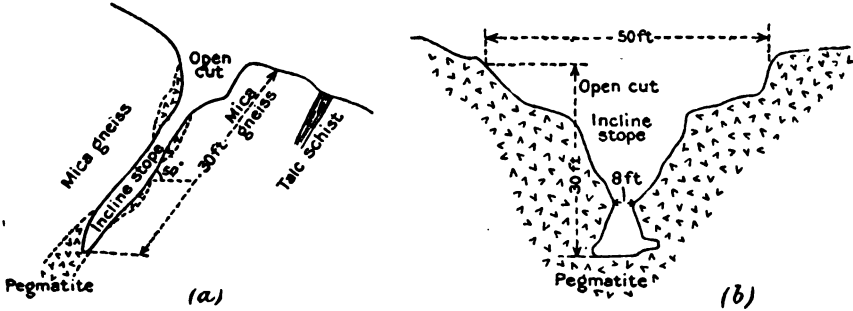


FIGURE 11.—Jim Wood mine, Jackson County, N. C. (a) Cross section, (b) section in plane of the "vein."

Gregory Mine.—The Gregory mine is 1 mile S. 20° W. of Panther Knob, near the top of the ridge running south from that mountain to the Cullo-whee Mountain divide. It was worked by an open cut about 50 feet back into the mountain side. On one side of the cut a deeper cut and room had been stoped out. The deepest part was probably not over 25 feet deep. The country rock is mica gneiss, which strikes N. 30° E. with a vertical dip. The pegmatite cuts across the gneiss with a strike of about N. 50° W. and a ver-

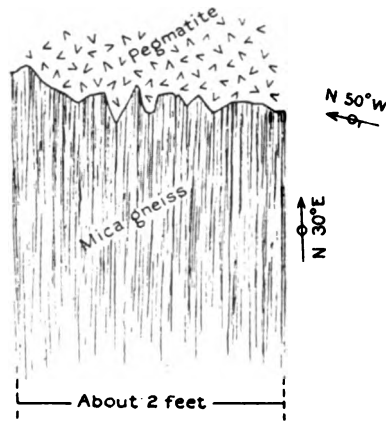


FIGURE 12.—Uneven contact of pegmatite and mica gneiss at the Gregory mine, Jackson County, N. C.

tical or high southerly dip. It is at least 10 feet thick in places and contained large quartz streaks and masses, one 4 feet through. The contact with the mica gneiss is not sharp, and in one exposure along the southwest wall was jagged, as shown in figure 12. Small mica is plentiful in parts of the "vein" and some good-sized crystals were left in a pillar over the stope. The mica has a "rum" color and is of good quality.

Bowers Mine.—The Bowers mine is 1 mile S. 30° E. of Panther Knob. The mine is in the east face of a steep mountain side, almost a cliff. It was worked by an open cut, not as wide as the pegmatite, 40 feet long into the mountain side, and with a maximum depth of 35 feet. A shaft was sunk from the inner end of this cut. The country rock is hard mica gneiss which strikes N. 55° E. and dips 70° NW. The pegmatite carries a large amount of quartz and is very hard. Near the top of the cut the pegmatite forks, a small streak, worked out for several feet, running westward and the other streak running northwestward. The mica is of excellent quality and has a fine "rum" color.

Judge Ferguson Mine.—The Judge Ferguson mine is about 5¼ miles S. 55° W. of Webster. It is one of the older mines and was reopened in 1906 by Mark Bryson. The workings at the time of visit consisted of an old open cut, two old shafts from the surface, and an interior shaft 55 feet deep at the end of the crosscut tunnel, with drifts and stopes. The new work consisted of a tunnel 180 feet long run irregularly toward the old workings and at a level 65 feet lower than the old tunnel. A plan of these workings is given in figure 13. The new tunnel had to be driven a distance of about 25 feet to cut the pegmatite, which it is reported subsequently to have done.

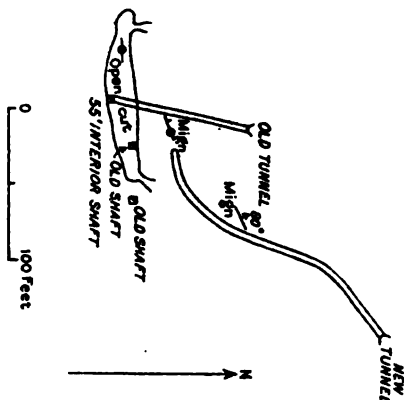


FIGURE 13.—Plan of Judge Ferguson mine, Jackson County, N. C. Mign., Mica gneiss.

The pegmatite strikes about east and west, with a vertical dip cutting across the mica gneiss country rock at a small angle. The latter has a strike slightly north of east and an approximately vertical dip. The pegmatite is about 12 feet thick in the old workings and contains a large quartz streak through part of its course. The mica occurs in the feldspar streaks between the quartz and wall rocks. It has a clear light color and much of it is of good quality, though a portion has the "A" structure.

J. H. Rochester Mine.—The Rochester mine is one-third mile southeast of Ocala post-office. It comprises two workings on different pegmatite bodies. In the one to the northwest an incline had been run down on the "vein." The country and wall rock at each opening is pegmatized mica gneiss striking N. 30° E. and dipping 50° SE. The pegmatite is conformable with the inclosing gneiss and about 3½ feet thick. About four-fifths of it, as exposed, consists of quartz. The mica is more plentiful near the walls of the pegmatite.

The principal work was done 75 yards to the southeast and consisted of an open cut 10 to 20 feet deep and 50 feet long on the outcrop, with a cross-cut tunnel and drifts, about 100 feet in all, at a lower level and under the

open cut, as shown in figure 14 (a) and (b). The pegmatite is from 1 to 5 feet thick, and conformable with the inclosing gneiss. Massive quartz is more or less prominent in different parts of the pegmatite. The mica is clear and has a dark-brown color with a tinge of green.

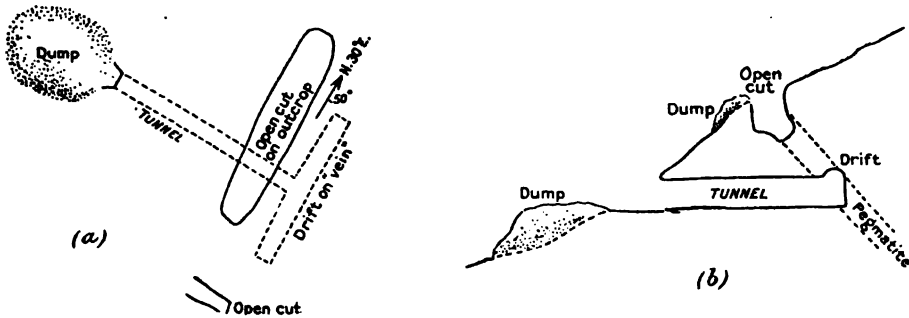


FIGURE 14.—J. H. Rochester mine, Jackson County, N. C. (a) Plan view; (b) cross section.

TRANSYLVANIA COUNTY.

Bee Tree Fork Mine.—The Bee Tree Fork mine is on the hillside opposite the mouth of Bee Tree Fork, on the headwaters of French Broad River. It was opened some years ago by Tarry McCall, and after lying idle many years was reopened in 1905 by C. H. Wolford. It has been operated by an open cut 50 feet long and 35 feet deep at the deeper end in the hillside. The cut is but little wider than the thickness of the "vein." The country rock is mica gneiss, which strikes about northeast with a dip of 45° NW. The "vein" has an irregular easterly strike with a dip varying from 45° to 80° N., cutting across the country rock with a sinuous course. The pegmatite ranges from 2 to 8 feet in thickness and is composed largely of quartz with smaller amounts of feldspar and mica. A small amount of pyrite and pyrrhotite is scattered through the rock. The mica has a clear "rum" color and is of good quality.

Reed Mine.—The Reed mine is 1 mile N. 60° E. of Montvale, and $2\frac{1}{4}$ miles S. 20° E. of Sapphire. It is owned by Dr. Robert Grimshawe, of Montvale. The mine has been worked by several tunnels at different levels, the greater part of which have fallen in. One 30-foot tunnel was driven in on a 5-foot "vein," which had a north-south strike and a dip of 30° W. This pegmatite is irregularly conformable with the inclosing mica gneiss country rock. It has a $2\frac{1}{2}$ -foot quartz streak in the middle with mostly feldspar on each side. About 75 feet to the north, on the opposite side of a small valley, the same "vein" has been worked by two levels (now stoped out between). One of these levels was driven back about 100 feet. The pegmatite had a strike of about N. 20° E. and a dip of 35° NW. in this tunnel. It had pinched down to about 18 inches in thickness with small scattering quartz lenses in it at the end of the tunnel. The mica from the Reed mine has a dark color and in part is "specked" with magnetite.

HAYWOOD COUNTY.

Shiny Mine.—The Shiny mine is near the head of Allen Creek, $1\frac{1}{4}$ miles north of Richland Balsam Mountain. It is 450 feet above the creek in the steep, cliff-like face of the west valley wall. Access was obtained over a rough trail and several sets of ladders. The workings consist of an open cut nearly 200 feet long in a north-south direction along the side of the mountain and up to 25 feet deep. The country rock is very hard garnet gneiss, which has a northerly strike with nearly vertical dip. The pegmatite is conformable with this and pinches and swells from a few inches to sev-

eral feet in thickness, with streaks branching out from it. The pegmatite contains quartz masses and streaks. Pyrrhotite is scattered through both the country rock and part of the pegmatite. The mica is rather thick in parts of the "vein," though only small-sized crystals were left exposed from the last operations. Sheets measuring 5 and 6 inches across were seen at the old trimming house in the valley below the mine. The quality of these sheets was very good.

BUNCOMBE COUNTY.

New Balsam Gap Mine.—The New Balsam Gap mine is near the head of North Fork of Swannanoa River, about 1 mile southeast of Balsam Gap. The mine is on the face of a cliff about 70 feet high and a few feet to one side of a waterfall over the cliff. It was worked by an open cut at the foot of the cliff, about 60 feet long, extending into the cliff. A tunnel or stope 15 or 20 feet high was then driven back under the cliff on the "vein" a distance of 70 feet. The full width of the pegmatite, 6 to 8 feet, was removed in the tunnel, and the waste was left to accumulate in the bottom as a floor for stoping out the "vein" above. The country rock is much-folded biotite mica gneiss striking north and south, with a high irregular dip to the west. The pegmatite cuts across the schistosity of the country rock with a strike of N. 45° E. and a nearly vertical dip. The pegmatite is very irregular in size and in one portion exposed in the roof of the tunnel it

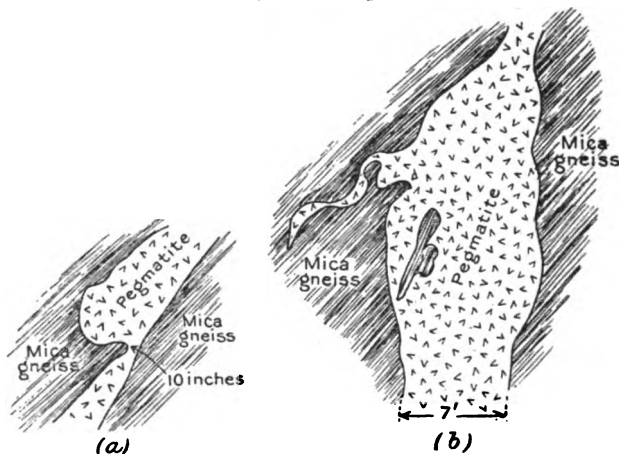


FIGURE 15.—New Balsam Gap mine, Buncombe County, N. C. (a) Section showing pegmatite pinched down to 10 inches and elbowing out abruptly; (b) irregularity of pegmatite exposed in end of tunnel; lenticular-shaped cross section with small side stringer and horse of mica gneiss.

pinches down to about 1 foot in width but abruptly elbows out again to several feet, as shown in figure 15 (a). The irregularity of the pegmatite is further shown by the exposure in the end of the tunnel, of which figure 15 (b) is a vertical cross section. The pegmatite pinches down in the upper part, is large in the middle, and smaller again at the bottom. On the west side there is an elbow in the "vein" with a small arm of pegmatite branching off into the mica gneiss. An irregular-shaped horse of gneiss was included in the "vein." The pegmatite is composed of the usual minerals segregated out into coarse masses in places. The quartz and feldspar occur in masses 2 or 3 feet thick, and the mica is richer in some portions than in others. One place in the roof where the pegmatite pinched down to a width of 2 feet carries abundant mica. The mica is good and has some biotite associated with it.

Connally Mine.—The Connally mine is 4 miles west of north of Black Mountain station, on the east side of North Fork of Swannanoa River. The country rock is diorite or hornblende gneiss, carrying mica gneiss bands. The mine was formerly opened by cuts and shafts on the hillside about 100 yards above the entrance to a new tunnel. The outcrop of the pegmatite at the old workings was marked by much massive quartz. A new shaft had been sunk near the old workings and pegmatite was encountered. The new tunnel was driven in an easterly direction for nearly 200 feet. Side tunnels were run near the end, as shown in figure 16, A. Irregularities in the formation were encountered at several places. At 1, figure 16, A, a small lens or streak of pegmatite cuts across the hornblende gneiss walls of the tunnel. At 2 there is a vertical contact of hornblende gneiss on the left and pegmatite on the right. For a number of yards at 3 there is hornblende gneiss in the bottom of the tunnel and pegmatite in the upper part. At 4 the pegmatite gives out and hornblende gneiss is encountered. The irregular nature of this contact is shown in figure 16, B, which represents the section (a) exposed on the south wall. The feldspathic part of the pegmatite forks into mica gneiss. At 5 and 8 there are irregular streaks of massive quartz. Between 6 and 7 there is a vertical contact between pegmatite and hornblende gneiss. At (b) there is another large irregular mass of quartz included in or a part of the pegmatite. It is shown in cross section in figure 16, C, as it appears in the north wall of the tunnel.

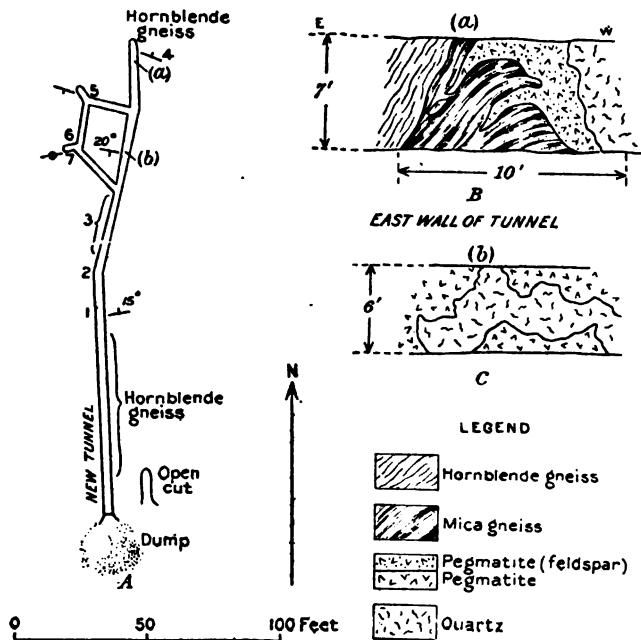


FIGURE 16.—A, Plan of Connally mine, Buncombe County, N. C.; reference figures described in text. B, section in east wall of tunnel at (a) in A. C, Section in east wall of tunnel at (b) in A.

The feldspar of the pegmatite is badly kaolinized, and it was the intention of Colonel Connally to test the deposit for kaolin. The mica occurs chiefly in the kaolin along the quartz masses and is much crushed in many places. The quantity of mica found in the new tunnel was not large, but the old workings on the hill above are reported to have yielded well. The mica obtained was of a clear light "rum" color and good quality.

YANCEY COUNTY.

Poll Hill Mine.—The Poll Hill mine is $1\frac{3}{4}$ miles west of south of Newdale, on the east side of South Toe River, just across the river from the Gibbs mine. This mine consists of two parts, both of which have been operated intermittently and actively since 1906. The part near the bank of the river was worked by the Burleson Mica Company, and that higher up on the hill by Hall Brothers & Burleson. The part near the river was being cleaned out at the time of visit and was equipped with a steam pump and hoist. The workings consist of an incline about 20 feet deep on the pegmatite and a tunnel to the northeast of it. The country rock is mica gneiss which strikes about N. 75° E. and dips 55° S. The pegmatite is only approximately conformable with the gneiss, and so far as seen varies from 10 to 15 feet in thickness. It contains numerous small horses or streaks of mica gneiss or schist included parallel with its walls.

The upper part of the mine has been worked at a number of places, and in such positions as to show an irregular pegmatite formation or several masses of pegmatite. The last operations had been in progress about one year at the time of visit and the nature of the work is shown in figure 17, A. A 70-foot tunnel was driven in a N. 75° E. direction on a mica "vein." From this an incline was run in a southwesterly direction on a dip of about 35° . The incline was about 70 feet long, 20 feet wide, and 10 feet high. A bench was left on the northwest side in barren rock. The waste and mica were hoisted from the incline by means of a hand whim at the head of the incline.

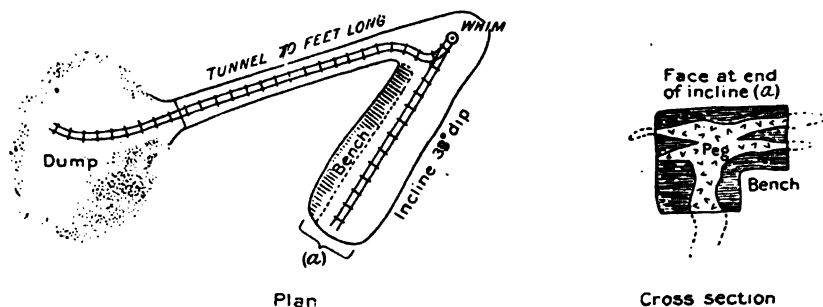


FIGURE 17.—A, Plan of Poll Hill mine, Yancey County, N. C. B, Cross section of pegmatite at end of incline at (a) in A.

The wall rock is biotite gneiss, through which the pegmatite cuts and into which it forks out. Figure 17, B, represents the vertical cross section of the pegmatite exposed in the face at the bottom of the incline. The position of the bench in barren gneiss is shown on the side. The incline was driven on the pegmatite where that rock was diverted from its course across the gneiss into lens-shaped masses. These lenses became smaller or pinched out in a short distance on each side.

The quality of the mica from the Poll Hill mine is good and the color a clear "rum."

Aley Mine.—The Aley mine is at the head of Browns Creek about 3 miles southwest of Micaville. It has been opened by at least three tunnels, one an incline, and by open cuts and a shaft 40 feet deep. The last work was that of the J. E. Burleson Company in 1904. The "vein" strikes N. 15° E. with a high easterly dip. It has been opened along its strike for a distance of nearly 100 yards up and down the slope of the mountain. The lowest opening is an old tunnel run in on the "vein" for drainage and development purposes. A shaft started higher up the hill to meet this old tunnel was never completed. At the time of visit a block of mica weighing nearly 100 pounds was found in the bottom of the shaft and several other

fine blocks of mica were found within 3 feet of the surface in a cut east of the shaft. The latter material may have been drift from the outcrop of the "vein" above, though it probably belonged to a second "vein" parallel to the first. A corresponding "vein" has been opened by an incline lower down on the hill above and east of the drainage tunnel. The mica from this mine has a rich "ruby" to "rum" red color and is of excellent quality for stove purposes.

Hensley Mine.—The Hensley mine is on Pigpen Creek about 2 miles west of south of Green Mountain. It is said that there were ancient workings at this mine. It was operated by the Hampton Mining Company in 1906, when the accompanying notes were taken. The mine was also worked at earlier dates by white people. The country rock is mica gneiss, with north-south strike and a nearly vertical dip. The pegmatite is conformable, or nearly so, with the schistosity of the inclosing rock. It occurs in lens-shaped masses 3 to 4 feet thick. The mine has been opened by two shafts, 40 and 45 feet deep and 15 feet apart, each one evidently having been sunk on a rich lens. In the space between the shafts, partly worked out, the overlapping of two lenses was well shown. (See fig. 18.) The gneiss and schist walls bend around the lenses. Fifty feet south of the shafts an open cut exposed a lens $2\frac{1}{2}$ feet thick and about 15 feet long lying in the gneiss. Some blocks of mica many pounds in weight have been found. Part is clay and iron stained near the surface and is used for electrical purposes, and part has a clear amber color and is suitable for stove use.

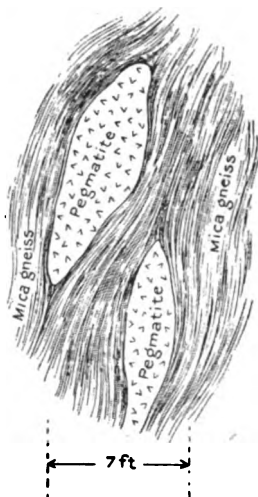


FIGURE 18.—Vertical cross section of pegmatite at Hensley mine, Yancey County, N. C.

Young Mine.—The Young mine is about 2 miles west of Boonford and 100 yards west of South Toe River. The mine has been opened by cuts, pits, tunnels, and shafts covering a width of more than 50 feet and for a distance of more than 200 feet. The workings extend from the south side over the top to the north side of a ridge about 100 feet high. The mine has been operated at several different times, the last time by the J. E. Burleson Company in 1904-5. The country rock is hornblende gneiss, biotitic near the contact with the pegmatite. The pegmatite outcrop crossing the creek on the south side of the ridge is about 100 feet wide. The strike of the formation is about N. 35° E. and the dip 75° SE. Streaks or horses of mica schist are included in the strike of the pegmatite and are parallel with it. The mica occurs in streaks parallel with these bands of schist, and the latter are left as walls to the workings in places. There is much small-sized mica

in the "veins" and some sheets of large size are reported to have been found. The quality is good and the mica is said to be especially fitted for electrical purposes.

MITCHELL COUNTY.

Knob Mine.—The Knob mica mine is a little more than 2 miles northeast of Spruce Pine. The pegmatite is inclosed in biotite gneiss or schist, with which it is roughly conformable. It strikes about N. 45° E. and dips about 40° SE. The pegmatite is coarsely crystallized next to the hanging wall and grades into fine-grained pegmatite or coarse granite on the lower side. Only the coarse pegmatite, called the "vein," is mined; this pinches and swells between 1 and 4 feet in thickness. The mine was first worked by open cuts on the outcrop and shallow inclines. Later a drift was run about 150 feet from the outcrop lower down on the hillside, and portions of the "vein" were stoped out to the open cut above. Figure 19 is a section in the plane of the "vein" and shows the nature of the work at the time of visit. The mica has a dark-green color and is "speckled," some abundantly, with dendritic spots of magnetite. Some crystals of large size are found, and one weighing 165 pounds was obtained at the time of visit in 1904. This block measured roughly 12 by 20 inches and was 30 inches thick. The mica was split and graded at the mine and shipped to electrical manufacturers. The splitting and rough trimming were done chiefly by women.

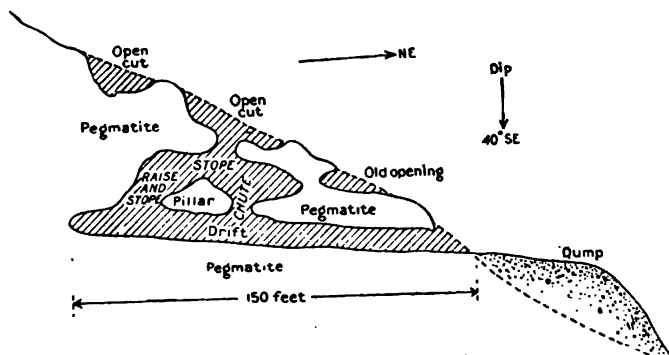


FIGURE 19.—Section in plane of pegmatite at Knob mine, Mitchell County, N. C.

W. W. Wiseman Mine.—The Wiseman mine is 2 miles northeast of Spruce Pine, on Beaver Creek. According to Mr. Mart Wiseman it was opened by James Wiseman and John Pendley in 1875. These men removed \$2,000 or \$3,000 worth of mica in one year's work. Later the mine was operated by Lum Blalock and Luke Lewis, and still later by other parties. About 1890 the mine went into the hands of the Southern Mica Company. The early workings consisted of a shaft carried down 30 feet and a tunnel 40 feet long along the vein.

At the time of visit (1904) the old workings had caved in badly, leaving a pit resembling an old open cut. The more recent workings of the Southern Mica Company were still open, however. A crosscut tunnel some 250 feet long had been driven into the "vein," along which drifts with extensive stoping were run. The country rock is highly schistose mica gneiss which has a varied dip and strike where it is cut by the tunnel. Several feet before the "vein" was reached the tunnel encountered coarse granite or fine-grained pegmatite, which grades into coarse pegmatite near the "vein." The coarse granite cuts across the schistosity of the gneiss, which trends N. 15° W. and has a 25° W. dip at the contact, whereas the granite has a strike more nearly east and west. Figure 20 shows the position of the workings and the relations of the rock formations. The crystallization of

the pegmatite as exposed in the walls of the drift is very coarse. Crystals of orthoclase feldspar 2 and 3 feet square had been cut through and the candle light reflected from the cleavage faces exposed outlined their shapes well. This mine is reported to have yielded large blocks of mica, one weighing about 2,000 pounds. Samarskite is said to have been found in masses of many pounds weight and broken up and lost before its nature was known.

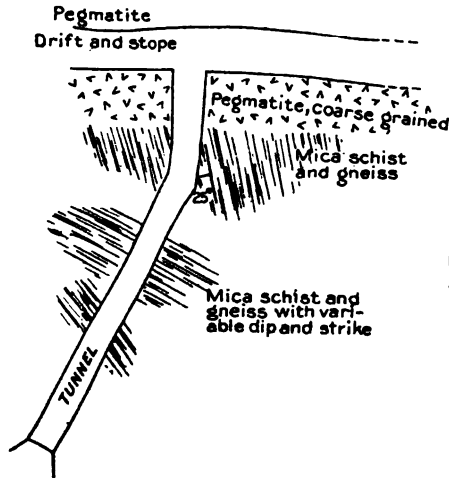


FIGURE 20.—Plan of the later workings at the W. W. Wiseman mine, Mitchell County, N. C.

Charles Ridge Mine.—The Charles Ridge mine is $1\frac{1}{2}$ miles south of west of Plumtree and one-half mile west of Spear, about 200 yards south-

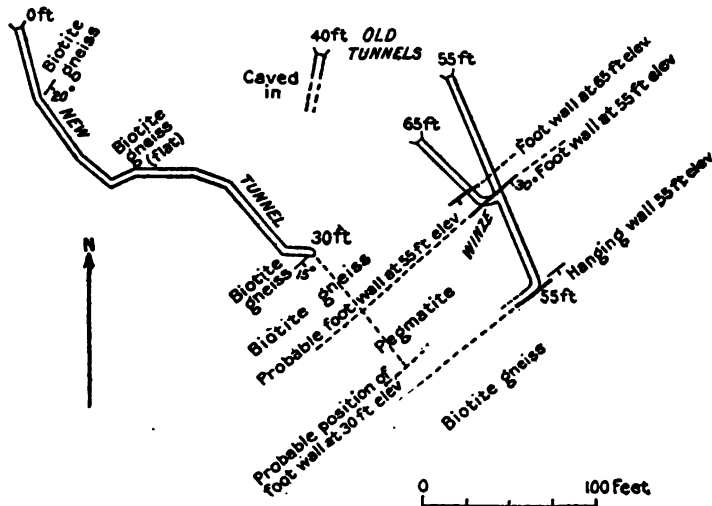


FIGURE 21.—Plan of Charles Ridge mine, Mitchell County, N. C.: figures give elevations above mouth of new tunnel. The position of the pegmatite is shown on the 55 and 65 foot levels; also the probable position at the level of the end of the tunnel.

east of the Justice mine. It was discovered about 1882 or 1883, by Ben Aldrich and worked by him for about six months. It has been operated at different times by Samuel Landers, Colonel Irby, and W. W. Irby. During 1905 and 1906 it was being reopened by A. Miller, C. W. Wisler, and J. W. Walters. The earlier work consisted of three tunnels and some pits. The new work consisted of a tunnel about 230 feet long at the time of visit. This tunnel was expensive, being run through very hard rock at the rate of about 3 feet a week and not being driven in a straight course. A plan of the workings and position of the pegmatite is shown in figure 21. The elevation of the new tunnel is given as zero, and the other three were run in about 40, 55 and 65 feet higher up and to the east. The new tunnel rises nearly 30 feet from its mouth to its head, thus losing much of the advantage gained through the position of its starting point. From measurements taken for the benefit of the miners it was found that the tunnel would have to be driven about 80 feet farther, if on a level, and in a direction S. 40° E., to strike the "vein."

The country rock is biotite gneiss, whose dip and strike vary, though in general the strike is northeasterly and the dip southeasterly. The pegmatite is large and is richer in mica near its walls than in the interior. There is a streak of highly foliated biotite schist 3 to 6 inches thick along the walls.

Plumtree Mine.—The Plumtree mine is one-half mile east of Plumtree, on Plumtree Creek. It was discovered by C. W. Burleson about 1870, and worked by him for about six months. It was later worked by Colonel English, Colonel Rorison, W. W. Avery, and others, and after a period of idleness was reopened again by the Burleson Brothers in 1906. The mine was operated by an open cut on the outcrop with a 30-foot incline and a tunnel or drift on the "vein" from a lower level. The country rock is of mica gneiss, interbedded with hornblende gneiss and the wall rock in mica gneiss. The pegmatite is conformable, or approximately so, with the inclosing formations and strikes about N. 25° W. with a dip of 10° to 25° NE. It is from 18 inches to 4 feet thick. The mica streak lies near the hanging wall and in places is separated from the wall by a quartz vein 3 to 5 inches thick. The crystals of mica are reported to be of good size, running up to 40 and 50 pounds in weight. Some of them are badly crushed and crumpled and suitable for grinding purposes only. The quality of the sound crystals is good. The sheets have a greenish cast and are in places slightly "specked."

Johnson Mine.—The Johnson mine is 2 miles east of Plumtree, on Plumtree Creek. The country rock at this mine is hornblende gneiss, biotitic near the contact with the pegmatite. The pegmatite is conformable, or nearly so, with the inclosing gneiss, which lies nearly flat in places and has gentle rolling folds in other places. The pegmatite varies from a few inches to 7 feet in thickness and is reported by the miners to be richest in mica where it is between 2½ to 4 feet thick. The main opening consists of a tunnel about 100 feet long, running N. 30° W. for 80 feet and then due north for 2 feet. For the last 30 feet of this tunnel the pegmatite is 7 feet thick and carries but little mica. Other tunnels have been run in different positions, following the directions in which the best mica was found. The rolling structure of the formation can be seen from the two dips and strikes. At the entrance to the main tunnel the strike was about N. 70° E. and the dip 20° N. A little way in the rock was nearly flat, and near the end of the tunnel the strike was due north and the dip 15° W.

The mica obtained from this mine is of the finest quality, with a rich "rum" color. One block is reported to have been found worth over \$100.

WATAUGA COUNTY.

Dobbins Mine.—The Dobbins mica mine is about 2 miles north of west of Elk Crossroads. It was operated extensively about 1890 and on a smaller scale about ten years later by the Blue Ridge Mica Company. There are two sets of workings about 250 yards apart, one at the foot of the hill and

the other on the top of the ridge to the northeast. The work near the road consists of five tunnels, with two shafts and other openings of "groundhog" nature. The tunnels have been run in at different levels on the hillside, in a space about 70 feet wide, showing a large pegmatite formation. These tunnels have directions varying from N. 25° to 45° E. and roughly show the trend of the pegmatite. The country rock is biotite gneiss and strikes between N. 30° and 40° E., with a nearly vertical dip. The pegmatite is conformable, or approximately so, with the inclosing gneiss. Portions of pegmatite rich in small mica were exposed in some of the workings, but in others there was little or no mica. The openings on the ridge consisted of three shafts and tunnels on each side of the summit. The openings were confined to a belt about 100 yards long in a direction N. 35° E. and about 40 feet wide. One deep shaft has been well timbered and was in a good state of preservation. The other openings had caved badly. But little mica had been left around these workings. The mica seen at the openings along the road was mostly of a dark-brown to greenish-brown color. Part was "speckled" and in "wedge" shaped blocks with the "A" structure. Some clear sheets were seen with good cleavage, but of rather dark color.

ASHE COUNTY.

Hamilton Mine.—The Hamilton mine is on the west slope of a mountain 2 miles northwest of Beaver Creek. It was re-opened by the Johnson-Hardin Company in 1907, since the accompanying notes were taken. The deposit was opened by two tunnels run into the hillside along the vein. In the upper and earlier one a shaft or winze was sunk 35 feet from a point about 20 feet in from the mouth of the tunnel. From the bottom of this shaft a curved tunnel was cut on vein material. The second tunnel was run at a lower level for a distance of 75 feet about south and did not connect with the upper one. This tunnel did not follow the pegmatite closely but seemed to cut across its strike at a small angle. The strike of the pegmatite appeared to be about N. 10° E. and the dip nearly vertical or to the east. The pegmatite is composed of feldspar and quartz in fairly coarse aggregates, with both muscovite and biotite in good-sized sheets. The muscovite mica is of excellent grade and has a clear light to dark "rum" color. The larger blocks of mica yielded sheets of 6 by 8 or 8 by 10 inches, but the principal production was in smaller sizes. The biotite occurs in sheets of nearly equal size and some of it is intimately intergrown with muscovite, the two having the same cleavage plane.

North Hardin Mine.—The North Hardin mine is on a ridge about 1½ miles west of Beaver Creek. It has been worked on a large scale and more systematically than is usual for mica in North Carolina. The mine was operated by two open cuts and other pits, three crosscut tunnels to the "vein," two shafts, and considerable drifting and stoping on the vein. These workings have proved the continuity of the pegmatite for a length of over 100 yards and show the thickness to vary from 3 to 8 feet. The country rock of the region is hornblende gneiss, but the mica deposit occurs in a smaller belt of biotite (probably granite) gneiss. The strike of the pegmatite is about N. 20° E. and the dip 75° to 80° E. At a place about 80 yards north of the main workings a shallow shaft was sunk in line with the "vein" on a small streak of pegmatite 18 inches thick, which was probably the main "vein" pinching out. Figure 22 shows the extent of the work open for examination at the time of visit. A large part of the stoping and drifts had caved in and could not be seen. The greater part of the vein above the tunnels shown in the figure had been removed, however, and future work should be directed to vein matter between old workings and to lower depths, easily attained with facilities for draining. Tunnel No. 3 is probably 50 feet higher than No. 1. The mine produced a large quantity of small block mica, yielding sheets 1 by 2 and 3 by 4 inches. A number of larger blocks, yielding sheets 6 by 8 and more inches square, were found with the smaller ma-

terial. Many small blocks of mica and one crystal over 10 inches thick and a foot wide was seen in the "vein," embedded in feldspar. The mica has a beautiful clear "rum" color and is of the best grade. Most of the blocks yield sheets of perfect quality.

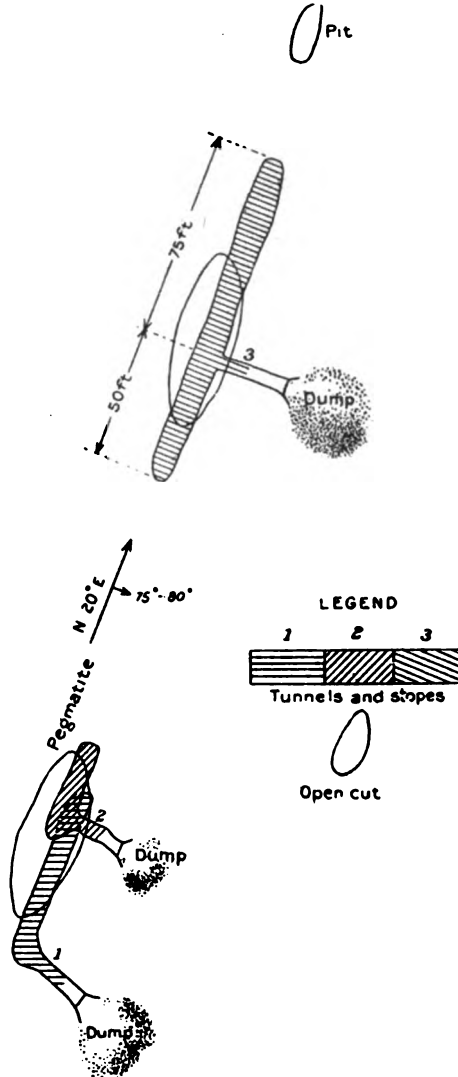


FIGURE 22—Plan of North Hardin mine, Ashe County, N. C.

South Hardin Mine—The South Hardin mine is near the top of a small mountain or hill about $1\frac{1}{2}$ miles southwest of Beaver Creek. This mine was first opened by small pits, trenches, and a tunnel along the "vein." The surface workings were at the summit of the hill and the tunnel on the out-crop about 40 feet lower down to the northeast. The mine was later oper-

ated by a 30-foot shaft near the top of the hill and an open cut about 75 feet long and 10 to 20 feet deep on the "vein."

The country rock of the region, like that of the North Hardin mine, a mile to the northwest, is hornblende gneiss. The mica-bearing pegmatite is inclosed in a smaller mass of biotite mica gneiss included in the hornblende gneiss. The pegmatite is conformable with the schistosity of the inclosing formations, which strike due northeast and dip 50° SE. at this point. The pegmatite is about 7 feet thick as exposed at the surface. The interior is fine grained or like coarse granite, whereas along the walls the crystallization is much coarser. The principal mica yield is reported to have come from the foot wall, along which massive quartz streaks up to 2 feet thick were found. It is said that the crystallization of the pegmatite was coarser below a depth of 15 feet and the quantity of mica in it was larger than near the surface. The color of the mica obtained was a clear "rum" and the quality the best.

The quartz streaks along the foot wall of the pegmatite contained beryl crystals from less than an inch to 6 or 8 inches in diameter. These crystals were of good golden and aquamarine color, though cloudy and only translucent. It was found they made very pretty gems for scarf pins, cuff buttons, etc., when cut *en cabochon*.

RUTHERFORD COUNTY.

Isinglass Hill Mine.—The Isinglass Hill mine is on the Southern Railway about 3½ miles north of Rutherfordton. A pegmatite formation over 30 yards thick has been found to carry mica in certain parts. The country

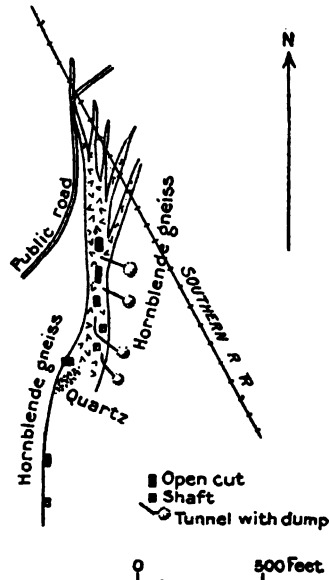


FIGURE 23.—Plan of workings and probable shape of the pegmatite in Isinglass Hill mine, Rutherford County, N. C.

rock is hornblende gneiss, badly folded and contorted, and the pegmatite is roughly conformable with it. The strike is east of north and the dip in general nearly vertical. The pegmatite near the mica workings is many yards thick and in a railroad cut 200 yards to the north shows only as small streaks,

probably stringers from the main mass after it had forked into smaller branches. The pegmatite has been traced over 200 yards to the south by prospect shafts, but it is not known how thick it is at these points. Mica was found most plentifully in the portion where the open cuts are shown in figure 23. It is principally associated with a massive quartz streak in this place. The depth to which the mica workings were carried could not be ascertained because they had caved in badly, owing to the soft, decomposed nature of the rocks. The mica is in large part badly "specked" with magnetic iron. To judge from the large quantity of sheets 2 to 5 inches in diameter left on the dump, mica must have been very plentiful where found. Much of this waste mica was either "A" or "wedge," however.

Since the operations for mica were suspended the deposit has been examined for its value as a kaolin mine, and for this purpose some of the tunnels on the east and shafts to the south were made. Good kaolin was found in some of the openings, but its extent had not been adequately proved at the time of visit. The following analysis of the kaolin, made by T. W. Smith, commercial chemist, Indianapolis, Ind., was furnished by Mr. Oliver, owner of the mine:

Analysis of Kaolin from Isinglass Hill Mine, N. C.

SiO ₂	44.12
Al ₂ O ₃	39.50
CaO .....	.08
MgO	Trace
FeO .....	.08
Alkalies .....	.81
Ignition	14.53
	<hr/> 99.12 <hr/>

Rational analysis:

Clay substance	95.59
Quartz	3.39
Feldspar	1.02
	<hr/> 100.00

WILKES COUNTY.

Joel Triplett Mine.—The Triplett mica mine is near Hendricks on Stony Fork, 16 miles from Wilkesboro. There are three mica prospects on this property, one of which was opened several years ago by a tunnel 40 feet long. A pegmatite about 8 feet thick had been exposed approximately conformable with the mica gneiss country rock. The latter had a strike of N. 30° E. and a dip of 35° SE. and contained numerous small lenses and masses of quartz and pegmatite throughout. Mica was segregated in various small-sized blocks along the walls of the pegmatite. Some 50 pounds of sheeted and cut mica were seen. The sheets ranged in size from 2 by 2 to 4 by 4 inches. In quality the mica varied from clear sheets with good cleavage to smoky or "specked" and "A" mica. The color of the best was rather dark greenish brown in sheets a sixteenth of an inch thick or more.

CLEVELAND COUNTY.

M. M. Mauney Mine.—The Mauney mica mine is about 1 mile southwest of the old Camp Call post-office, or 9 miles northwest of Shelby. It was first worked over thirty-five years ago and has not been worked within twenty years. The country rock is much crumpled mica schist-gneiss with a general strike of about N. 45° W. The pegmatite cuts across this with a strike of N. 20° E. and a nearly vertical dip. The part exposed in the old workings is composed of a quartz bank about 5 feet thick with 2 to 4 feet of feldspar, quartz, and mica on both sides. The mine was worked by an

open cut 20 feet deep and 40 feet long, and a shaft with tunnels, both now fallen in. The mica streak was all removed on the west side of the quartz ledge in the bottom of the open cut and only partly so on the east side. The mica is of fine quality, with a clear "rum" color. Specimen sheets measuring a foot across have been kept in the Mauney home.

S. J. Green Mine.—The Green mine is about 7 miles northwest of Shelby. The mine was opened in the seventies and operated again at later dates. The workings have fallen in badly and but few notes were obtained. The country rock is mica schist-gneiss striking north with a dip of 70° W. The vein strikes about N. 70° E., as shown by the position of eight or ten shafts and pits with tunnels. These workings are all within a distance of about 60 yards of one another. Streaks of massive quartz up to 3 feet thick were encountered in the pegmatite in the workings. In one of the workings the material was obtained from the north wall of one of the quartz ledges. The pegmatite is rich in feldspar, more or less kaolinized in places. The mica is of good quality and has a clear "rum" color.

Indian Town and Casar Mines.—The Indian Town and Casar mines are in the north end of Cleveland County, 3 miles north of east of Casar and on the southeast side of Casar, respectively. There is so much similarity in the occurrence in each group of mines and so little to see of the formation at any one of the separate mines that a general description will answer for all. The Indian Town mines cover an area of over a square mile and consist of a dozen or so small open cuts or shallow shafts which have caved in badly. The same may be said of the deposits near Casar and of one near Carpenter Knob, 5 miles east of Casar. The country rock of this general region is a highly schistose gneiss with mica, cyanite, and garnet as constituent minerals. The gneiss has been much folded and crumpled over the whole region and has been intruded by granite masses in places. The pegmatite bodies, opened for mica, appear to cut across the schistosity of the gneiss as a general rule, though in some places they lie conformable with it. They range in thickness from 2 to 15 feet and are rather irregular in shape. In most of the deposits masses of quartz are encountered, generally in the form of ledges or veins within the pegmatite. The occurrence of large bodies of feldspar or its alteration product, kaolin, with the mica is not common. Much of the mica obtained in this region is of excellent quality and has a rich "rum" color. Part has "A" markings, but large sheets have been cut between the "A" lines.

LINCOLN COUNTY.

Thomas Baxter Mine.—The Baxter mica mine is about three-fourths of a mile from the southwest corner of Lincoln County, on the old Rutherfordton road. It is probably the oldest mine in the county and is reported to have been opened before 1870. The workings have nearly all fallen in, and little could be determined of the formation. There were six to eight shafts and cuts with tunnels. One shaft is said to have been 65 feet deep, with good mica in the bottom. The ground-water level in a well near the mine was about 35 feet below the surface. The workings fall within an area about 50 yards wide and 75 yards long in a direction north of east. The country rock is much-folded mica schist-gneiss. A large quartz vein or ledge outcrops in a direction N. 70° E. through the workings. The mica is of the best quality, splitting well, and has a beautiful clear "rum" color. Large quantities of weathered small sheet mica 1 to 2 or 3 inches in diameter are scattered around the mine. It is said that the mine was a large producer, including many pounds of large sheets, as 8 by 10 and 10 by 12 inches.

M. M. Hull Mine.—The Hull mine is about 2½ miles northeast of Hull's Crossroads. This mine, which was opened about 1891, is sometimes called the Rock Cut mine. The work consists of a cut 40 feet long, 20 feet deep, and 5 feet wide. The pegmatite strikes N. 70° E. and is nearly vertical. It

cuts across the cyanitic mica gneiss country rock, which strikes N. 10° E. and dips 50° SE. Bunches of small mica are still left in the walls. The color and quality of the mica are of the best, and some sheets 10 by 14 inches are reported to have been found.

John Dillinger Mines.—The Dillinger mines, of which No. 1 is 2 miles south of Henry on the roadside and No. 2 is on a branch one-fourth mile west of the same road, were worked in 1905 and 1906 by the Cawood Mica Company. At each mine the country rock is much folded cyanitic mica gneiss. The pegmatite streak in each is irregular and has an east-west strike. Each mine was opened by a cut from 18 to 20 feet deep. In the No. 1 mine much of the mica found was "A," but of good color and with some clear portions. In the No. 2 mine the pegmatite had quartz ledges in it and the most mica was found alongside of these. Beryl was also reported as found in this mine.

STOKES COUNTY.

Joe Hawkins Mine.—The Hawkins mica mine was first opened about 1890 by people living in the county and during 1903 was again operated by the Empire Mica Company, of New York. It is about 2½ miles southwest of Sandy Ridge, in the northeastern part of Stokes County. The mica occurs in an irregular massive pegmatite formation, in which feldspar and quartz form large separate masses. The pegmatite varies from 6 to 12 feet in thickness, as exposed in the workings, and is approximately conformable to the inclosing mica gneiss country rock. The latter strikes a little north of east and dips about 35° N. Much of the quartz of the pegmatite occurs in bands or sheets, from a few inches to about 2 feet in thickness, lying parallel with the strike of the pegmatite. But little mica had been left in the "vein" from the last work, and much of that seen was of the "wedge" and "A" nature, with good portions between the "A" structure lines. Some of this wedge and distorted mica included rough garnets, either in crystals or flattened between the laminae. The workings consist of two open cuts, with an incline on the pegmatite from one, and three shafts 20 to 30 feet deep with tunnels connecting them. In all there are nearly 150 feet of tunnels and incline. Figure 24 gives a general plan of the workings.

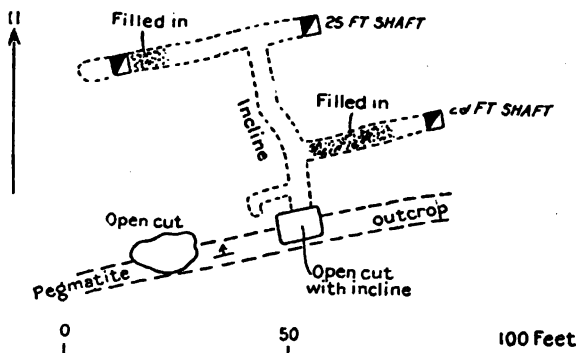


FIGURE 24.—Plan of Joe Hawkins mine, Stokes County, N. C.

Hole Mine.—The Hole mica mine is on the ridge between Dan River and Big Creek, near the mouth of the latter, and near Tulip postoffice. There are two separate mica-bearing pegmatites at this mine, opened at points about a third of a mile apart in an east-west direction. The principal deposit consists of a large pegmatite over 20 feet thick, striking nearly east and west with a dip of 30° N. As exposed in the open work on the outcrop

and small inclines, the pegmatite is composed of three bands or veins of massive quartz from 4 to 6 feet thick, with two beds of feldspar 4 to 7 feet thick between them. It is said that another feldspar band was developed beneath the lower quartz vein exposed at the time of visit, but this was covered with rubbish and could not be examined. The quartz and feldspar bands or veins are parallel and dip with the pegmatite to the north. The feldspar has kaolinized to a large extent and has been removed from the two veins exposed in inclines 10 and 20 feet deep. There were smaller masses and streaks of quartz 1 to 10 inches thick in the large feldspar streaks. Figure 25 is an ideal cross section of the pegmatite. The pegmatite can be traced a number of yards along the outcrop by massive white quartz boulders. Mica occurs through the feldspar masses and along the

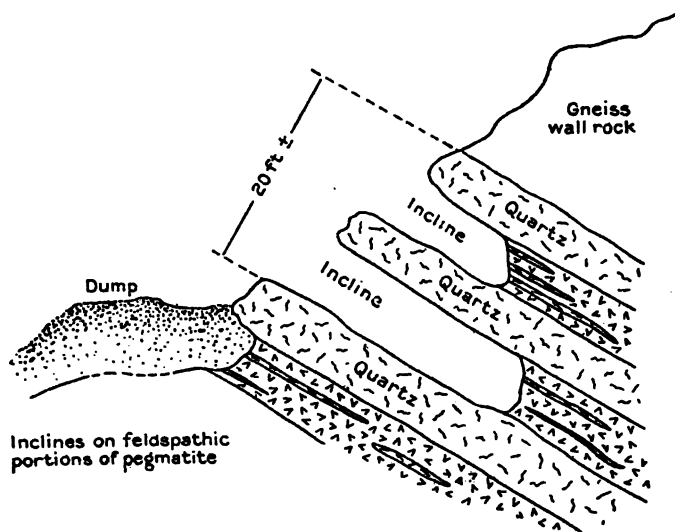


FIGURE 25.—Ideal cross section at Hole mine, Stokes County, N. C.

contact with the quartz streaks. The mica is partly of the "A" variety, and a 20-pound block of such mica was seen in the face of one of the veins. The mica has a brownish or smoky color.

At the other outcrop a few small open cuts and an incline 20 feet deep have proved the pegmatite for about 200 feet along a steep hillside. The pegmatite here is conformable with the mica gneiss country rock and is several feet thick. The dip and strike are very much the same as at the deposit first described. The feldspar of the pegmatite has not been kaolinized, however, and the formation is fairly hard. Only small mica blocks were seen in the hard rock, and this mica was of clear dark-green color, considerably ruled.

ORIGIN.

Mica of commercial size in North Carolina occurs only in pegmatite. There has been considerable difference of opinion concerning the origin of this rock in different regions, some writers arguing for intrusion as an igneous magma, others for deposition from solution. One group maintains that pegmatite formed as dikes, the other that it formed as veins. Still other authors consider pegmatite to be the product of aqueo-igneous processes in which there are all gradations between the conditions of a magma and those of a solution. Accordingly, it would be impossible to draw a sharp

line between pegmatites formed as dikes and those formed as veins. In some places the nature of the pegmatite and its relation to the accompanying rock are such that it may be stated with a fair degree of certainty to which class the deposit belongs.

In the mica-bearing pegmatites of North Carolina there are features that may be interpreted as showing an intrusive origin in one place and a solution deposit in another place. On the other hand, a large number of the deposits possess features characteristic of both dikes and veins, so that it is not possible to assign one method of formation or the other. It is probable that the greater number of the pegmatites opened for mica in North Carolina approach conditions of vein formation more closely than they do those of dike formation. This is in contrast with the mica bearing pegmatites of South Dakota,* which, in the greater number of places, are thought to possess features characteristic of dikes rather than of veins.

Features observed in pegmatites that may indicate vein origin are the presence of quartz veins or sheets oriented parallel to the walls; the similarity of these quartz veins or sheets to ordinary quartz veins in the mica region; horses of wall rock in sheetlike bodies lying parallel to the walls (by intrusion such sheets would tend to be turned or bent at an angle to the walls); the occurrence of pegmatite in small lens-shaped bodies; balls, veinlets, and other replacement deposits, some of them entirely disconnected with other pegmatite masses. The following conditions are possible evidence of intrusion: The occurrence of irregular-shaped horses and distorted sheetlike horses without parallelism to the walls; a typical coarse granite texture and its persistence through a considerable distance; a bending of the schistosity of the inclosing rock around pegmatite bodies without evidence of replacement (this may also take place around deposits from solution in which the force of crystal growth has distended the wall rock).

PRODUCTION.

The total values of the production of mica in North Carolina during the years 1908, 1909, and 1910 were as follows: For 1908 the production amounted to 599,234 pounds of sheet mica valued at \$114,540, and 1,308 short tons of scrap mica valued at \$13,330, giving a total value for that year of \$127,870; for 1909 the production consisted of 1,296,274 pounds of sheet mica valued at \$122,246, and 2,607 short tons of scrap mica valued at \$26,178, the total value being \$148,424; the production for 1910 amounted to 455,020 pounds of sheet mica valued at \$193,223, and 3,074 short tons of scrap mica valued at \$37,237, making a total value of \$230,460. An analysis of the above figures will show that while the value for the 1908 production was low as compared to previous years, shown in the table following, the value has steadily come up and in 1910 was greater than any previous year recorded. There is given in the following table the approximate value and distribution of the production of mica (both sheet and scrap) by counties for the years 1906 to 1910, inclusive.

*Mica deposits of South Dakota: Bull. U. S. Geol. Survey No. 380, 1909, pp. 382-397.

**PRODUCTION OF MICA IN NORTH CAROLINA DURING 1903-1910,
BY COUNTIES.**

County	1906	1907	1908	1909	1910
Ashe.....	\$ 4,000	\$ 1,500	\$ 1,200	\$ 155	\$ 500
Buncombe.....			50		
Cleveland.....					3,040
Haywood.....	15,975	17,000	15,000		5,600
Jackson.....	20,899	31,625	22,600	4,852	12,728
Lincoln.....	210	300	0		0
McDowell.....	0	0	500	0	500
Macon.....	47,863	34,525	20,800	45,632	50,300
Madsen.....					780
Mitchell.....	51,540	76,846	35,620	59,710	93,890
Stokes.....	731				200
Transylvania.....	11,275	3,500	2,100	5,415	6,140
Watauga.....	916	30			
Yancey.....	64,284	59,880	30,000	32,660	56,784
Totals.....	\$ 217,606	\$ 225,203	\$ 127,870	\$ 148,424	\$ 230,460

The next table gives the value of the total production of mica, including both sheet and scrap, for the years 1900 to 1910, inclusive.

PRODUCTION OF MICA IN NORTH CAROLINA, 1900-1910.

Year	Sheet Value	Scrap Value	Total Value
1900.....	\$ 65,200	\$ 36,262	\$ 101,462
1901.....	79,849	14,200	94,049
1902.....	81,651	2,219	83,872
1903.....	86,300	2,400	88,700
1904.....	100,724	3,410	104,134
1905.....	100,900	3,375	104,275
1906.....	203,756	11,940	215,696
1907.....	202,958	15,250	225,203
1908.....	114,540	13,830	127,870
1909.....	122,246	26,178	148,424
1910.....	193,223	37,237	230,460

In order to show the ratio of the production of mica in North Carolina to the total production in the United States and the value of the imports, there is given in the next table figures covering these points for the years 1903 to 1910, inclusive.

**PRODUCTION OF MICA IN THE UNITED STATES AND IN
NORTH CAROLINA AND THAT IMPORTED INTO THE
UNITED STATES FROM 1903-1910.**

Year	Production in N. C.	Production in U. S.	Import
	Value	Value	Value
1903.....	\$ 88,700	\$ 143,128	\$ 317,969
1904.....	104,134	120,316	263,714
1905.....	104,275	178,588	403,756
1906.....	217,696	274,990	1,012,603
1907.....	225,203	392,111	952,259
1908.....	127,870	267,925	266,018
1909.....	148,424	280,529	618,813
1910.....	230,460	337,037	724,525

The average prices of sheet mica in the United States during the years 1908, 1909, and 1910, respectively, were 24.1 cents per pound in 1908; 12.9 cents per pound in 1909, and 11.5 cents per pound during 1910. The average price of sheet mica per pound in North Carolina during 1908 was 19.1 cents; during 1909 it was 9.4 cents, and during 1910 it was 42.5 cents, the price varying according to the size and quality of the sheets placed on the market. The average price per ton of scrap mica in North Carolina during 1908 was \$14.02; during 1909 it was \$11.26, and during 1910 was \$13.10.

QUARTZ (FLINT).

No quartz has been produced in North Carolina since the year 1907. The principal use that has been made of the North Carolina quartz has been as a flux in copper smelting, and practically all that has been mined was obtained from Cherokee County and used in the copper smelters at Ducktown, Tennessee.

Investigations have been made of the kaolin deposits of the western part of this State with a view to the possibility of their use for pottery or porcelain industries; and, if such an investigation should result in the establishment of any large plants in this State, there will be a considerable demand for a quantity of the quartz that occurs in Piedmont and Western North Carolina. In the table below there is given the production of quartz in North Carolina since the year 1901.

PRODUCTION OF QUARTZ IN NORTH
CAROLINA, 1901-1910.

Year	Quantity	Value
	<i>Tons</i>	
1901.....	3,000	\$ 7,500
1902.....	4,500	11,250
1903.....	29,462	36,827
1904.....	32,972	36,269
1905.....	32,648	13,659
1906.....	20,963	12,578
1907.....	4,226	1,664
1908.....		a
1909.....		a
1910.....		a

a Small quantity of quartz.

BARYTES.

Barite, or barytes, as it is known commonly, a sulphate of barium (BaSO_4) is a heavy white crystalline mineral with a perfect prismatic cleavage and is found rather widely distributed in nature. It does not usually occur in well-defined veins, but is more often found in a series of pockets or lenses of varying dimensions. These are more or less in line, often filling the dip of the rock with which they are associated,

which in most cases is limestone. In some instances the rock is entirely decomposed and the pockets of barytes occur in clay. A mineral commonly associated with barytes is galena, a lead sulphide. On account of the alteration of the rocks with which the barytes is associated, it is usually more or less iron stained so that it is often necessary for the barytes to be ground, washed, and bleached with acids in order to purify it. Some, however, is found of sufficient purity so that it does not need any washing or bleaching whatever.

The uses for barytes are somewhat varied, but by far the greater part of this mineral produced is used in the manufacture of mixed paints, in the ground, or ground, floated, and bleached condition. It has a permanently pure white color, unaffected by the weather or by causes which in most cases will blacken white lead; but on account of its crystalline nature it is too transparent to be used alone as a white pigment. It is used, however, in mixed paints with either white lead or zinc white, or a combination of both. One very white pigment, which is composed partly of barytes, is lithopone, which is especially adapted for interior use in enamel and wall finishes. *Blanc fixe* is a precipitated form of barium sulphate which is used as a base on which lake colors are precipitated. It is also employed in the manufacture of wall paper, rubber, and in tanning leather.

The principal barytes deposits of North Carolina are in Madison County in the vicinity of Marshall, Stackhouse, Sandy Bottom, and Hot Springs; and in Gaston County, about 5 miles from Bessemer City. North Carolina barytes is of good quality and occurs in considerable quantity, and any increase in price in the value of this mineral is of interest to this State. The Payne-Aldrich Tariff increased the duty on raw barytes 100 per cent, but made no change in the duty on the manufactured product. During 1909, the first year of the operation of the increased duty on raw or unmanufactured barytes, there was a small decrease in the importation as compared with 1908, but in 1910 the imports increased more than 91 per cent.

PRODUCTION.

The production of crude barytes in North Carolina for the past three years has been made by but one producer, and the figures, therefore, can not be given separately. In the following table there is given the production of barytes in North Carolina from 1901 to 1907, inclusive. The productions for 1908, 1909, and 1910 are given in the general mineral table, page 10, under "Miscellaneous."

**PRODUCTION OF CRUDE BARYTES IN
NORTH CAROLINA, 1901-1907.**

Year	Quantity Short Tons	Value
1901.....	6,890	\$ 20,865
1902.....	14,679	44,130
1903.....	6,835	21,347
1904.....	13,413	33,930
1905.....	5,545	21,670
1906.....	3,340	10,020
1907.....	6,785	18,855

MONAZITE.*

The world's sources of supply of monazite for many years have been Brazil and the United States. The greater part of the monazite produced in the United States is used in this country, and, for a number of years, the supply has come principally from North Carolina, with smaller amounts from South Carolina. While the amount of monazite produced in North Carolina has for the last two years steadily decreased, due to the large amount imported at a lower price than it could be produced in this country, this is still one of the important minerals mined in the State. The demand for this mineral, because of its thorium content, is steadily increasing. Mr. Douglas B. Sterrett of the U. S. Geological Survey has made a brief report† on the monazite deposits of the Carolinas, which is given below:

MONAZITE DEPOSITS OF THE CAROLINAS.

BY DOUGLAS B. STERRETT.

Monazite has earned a prominent place in the commercial world through the rare-earth metal, thorium, which it carries as an accessory constituent. As a source of cerium and other rare-earth metals, also, monazite is of great interest to chemists. In composition it is essentially an anhydrous phosphate of cerium, praseodymium, neodymium and lanthanum in which thorium and silica are present in variable amounts. The amount of thorium in monazite ranges from less than 1 to 20 per cent or more, but its average amount in monazite obtained for commercial purposes varies between 3 and 9 per cent.

Though sometimes found in large crystals and masses of many pounds' weight, monazite for economic purposes is obtained in the form of sand, occurring in opaque to translucent and in some cases transparent grains and crystals. Monazite ranges in color mainly from light yellow to reddish yellow and brown; some of it is greenish. The freshly broken and unaltered mineral has a resinous to adamantine luster, which is especially marked on the cleavage faces. The mineral is brittle and has a hardness of 5 to 5.5. It can readily be crushed between the teeth and yields a soft grit, quite distinct from the harder minerals sometimes mistaken for it. The specific gravity ranges from 4.9 to 5.3 and is generally over 5.

The principal use made of the thorium extracted from monazite is in the manufacture of incandescent mantles for gas lighting. These mantles are made by immersing sections of a cotton gauze or netting, woven in tubular form, in a saturated solution of the salts of certain rare earths. The composition of this mixture of salts used by different manufacturers is kept

*See also the following reports of the North Carolina Geological Survey: Bulletin No. 9; Economic Papers No. 6, pp. 58-61; No. 8, pp. 34-40; No. 9, pp. 40-45; No. 11, pp. 37-42; No. 14, pp. 103-123; and No. 15, pp. 61-68.

†U. S. Geological Survey, Bulletin 340, Part I, pp. 272-285.

secret, but it is said to contain thorium largely in excess of the other constituents. The sections of the tubes are then dried after one end has been drawn into the form of a mantle by a platinum wire. When dry, the organic matter of the cotton is burned off and the mantle is saturated with some form of wax, which holds it in shape during shipment and is readily burned off when it is set up for use.

The production of monazite in the United States for commercial purposes has, up to the present time, come entirely from North and South Carolina. The occurrence of the mineral and the development of the industry in these States have been described in reports by Henry B. C. Nitze,* Joseph Hyde Pratt,** L. C. Graton,** and the writer.†

The value of the production of monazite from the Carolinas is small compared with that of the more important minerals produced in the United States. The benefit to the region in which the monazite is mined, however, has been considerable.

The present paper is intended to furnish general information on monazite, including a description of the deposits in the Carolinas and of the occurrence of the minerals in them, with a discussion of their bearing on its origin. The data used were obtained during brief visits to different parts of the region.

Acknowledgment is here made for the courtesy and general information received from the various operators in the monazite field. Among these are Mr. George L. English, of the National Light and Thorium Company; Mr. W. F. Smith and Mr. M. E. Gettys, of the Carolinas Monazite Company; Mr. Hugh Stewart, formerly of the British Monazite Company; and Mr. Herman Wanke, of the German Monazite Company. Further acknowledgment is made to Mr. A. Keith for valuable criticism.

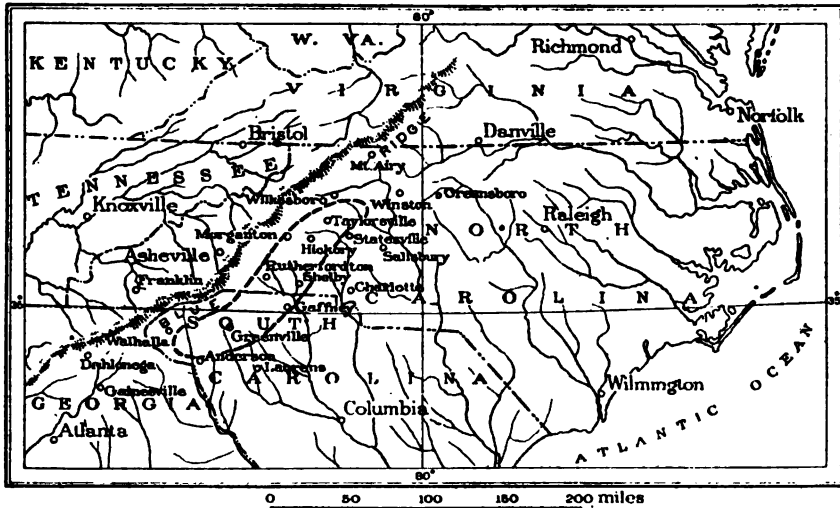


FIGURE 26.—Map showing area of monazite deposits of known commercial value in southern Appalachian region.

GEOGRAPHY.

Geographically, the area in which deposits of monazite of commercial value have been found lies in the central portion of Western North Carolina and

*Monazite and monazite deposits in North Carolina: Bull. North Carolina Geol. Survey, No. 9, 1895.

**Monazite: Mineral Resources U. S. for 1901 to 1903, U. S. Geol. Survey, 1902 to 1906. Also Mining Industry in North Carolina, an annual publication of North Carolina Geol. Survey, 1901, 1903, 1904 and 1905.

***Gold and Tin deposits of the Southern Appalachians: Bull. U. S. Geol. Survey No. 293, 1903, pp. 116-118.

†Monazite: Mineral Resources U. S. for 1906, U. S. Geol. Survey, 1907.

in the extreme northwestern part of South Carolina. Fig. 26 shows the area containing monazite deposits of known commercial value. This area covers about 3,500 square miles and includes part or all of Alexander, Iredell, Caldwell, Catawba, Burke, McDowell, Gaston, Lincoln, Cleveland, Rutherford, and Polk counties in North Carolina, and Cherokee, Laurens, Spartanburg, Greenville, Pickens, Anderson, and Oconee counties in South Carolina. The larger towns within or near the monazite region are Statesville, Hickory, and Shelby in North Carolina, and Gaffney, Spartanburg, and Greenville in South Carolina. The appearance of Alexander County, N. C., in the list of counties with valuable monazite deposits is the result of prospecting by mining companies during 1907.

PHYSIOGRAPHY.

Physiographically, North and South Carolina are divided into three parts. These are the Coastal Plain, extending from the Atlantic Ocean northwestward for 100 to 150 miles; the Piedmont Plateau, extending from the limits of the Coastal Plain northwestward for 100 to 130 miles to the foot of the Blue Ridge; and the mountain region, extending northwestward from the Piedmont Plateau to the State lines. The Coastal Plain and the Piedmont Plateau are prominent in both States, but only North Carolina contains a large portion of the mountain area.

The Coastal plain is a broad, nearly flat stretch of country rising from sea level on the southeast to an elevation of a few hundred feet on the northwest, in which direction it is practically limited by the boundaries of the rock formations of which it is composed. The Piedmont Plateau is an elevated district rising from a few hundred feet above sea level on the southeast to 1,200 or 1,500 feet on the northwest. It forms a plateau much dissected by valleys from 50 to 200 or 300 feet deep, and its regularity is further disturbed by scattered mountain peaks and smaller hills rising above its general level. The features of the plateau are best observed from a prominent ridge or one of the smaller hills of the region. In the mountain region are included the Blue Ridge and its foothills, and the higher mountains to the northwest. The country in the mountain region is exceedingly rough, and the elevations range from 1,500 to over 6,500 feet.

The region in which valuable deposits of monazite have been found may be defined as a belt from 20 to 30 miles wide and over 150 miles long. (See fig. 26, p. 73.) This belt lies wholly within the Piedmont Plateau, and borders closely on the Blue Ridge, to whose general course it is roughly parallel.

GEOLOGY.

Formations.

The most important rocks of the monazite belt are gneisses and schists. These include the Carolina gneiss, the Roan gneiss, and gneissoid, porphyritic, and massive granites. Other rocks are pegmatite, peridotite and allied rocks, quartz diorite, and diabase.*

The oldest formation in the monazite region is of Archean age and is called the Carolina gneiss. It is the most extensive formation and appears in nearly every section. The composition and structure of the Carolina gneiss are varied. The most common types are mica, garnet, cyanite, and graphite gneisses and schists, or combinations of two or more of these types. These rocks range in color from light gray to dark gray, and in many places where graphite is abundant in them have a light bluish-gray to bluish-black cast. Some of the gneisses and schists are fine grained and are composed of several distinguishing minerals, as biotite, muscovite, cyanite in fine needles, and graphite, besides fine grains of quartz and other minerals; other rocks are composed of the same minerals in coarser grains or flakes. Garnet appears in both fine and coarse grained gneisses and schists and may be

*The formation names used in the description of these rocks are taken from Keith, A., *Geologic Atlas U. S.*, folios 116 (Asheville), 124 (Mount Mitchell) and 147 (Pisgah) and others.

fairly large, even in the rocks of finer grain. The presence of much pegmatitic material is a characteristic feature of the Carolina gneiss.

The Roan gneiss is the next oldest formation in the region and is also of Archean age. It consists of hornblende gneiss and schist, with here and there the less metamorphosed phase, diorite. The hornblende gneiss and schist are nearly black to dark green in color, and are composed chiefly of small interwoven and matted hornblende crystals. These hornblende rocks grade into diorite, which is also dark colored but contains a noticeable amount of feldspar and has a granitoid texture. Bands of mica gneiss or schist are included in many both large and small masses of Roan gneiss. This formation is prominent along the northwest side of the monazite belt, throughout its length. In the central and more eastern portions, however, it is of less importance and in many places does not appear at all.

The age of many of the granites and granite gneisses has not been determined, though a part are probably Archean. In importance, granite and its different phases are second and are particularly prominent in many localities where extensive monazite deposits have been found. In composition the granite may be biotitic, muscovitic, or hornblende; its texture may be porphyritic, massive, gneissic, or schistose. Where both porphyritic and schistose the feldspar phenocrysts generally assume an augen form, caused by crushing and elongation in the direction of shearing. Some large masses of granite gneiss have an abundant development of small red garnets. The occurrence of much quartz in veins and veinlets throughout the mass is a characteristic feature of most of the granites of this region. Some of this quartz is simply massive; at other places it has a more or less well-defined crystal form. Drusy surfaces are not uncommon on such crystals. The abundance of quartz veins is not invariably confined to the granite masses, but in numerous places extends some distance from the contact of the granite into adjacent formations.

Pegmatite is a common rock throughout the monazite region, especially in those areas where commercial deposits of monazite are found. Two principal occurrences of pegmatite are here recognized. In one it forms distinct masses or bodies with the typical composition and texture—that is, it is composed of quartz and feldspar, with or without mica and other accessory minerals, crystallized out on a large scale. The other type is a pegmatized gneiss, representing the addition of the pegmatite minerals to the gneiss, with perhaps some re-crystallization of portions of the inclosing rocks. In some places secondary quartz is the principal mineral added, while feldspar appears in smaller quantities. In others the feldspar is more prominent, and is prone to assume a porphyritic form in the gneiss, producing a typical augen gneiss. Very commonly the gneisses and schists are banded with or cut at all angles by streaks of pegmatitic or granitic material. The re-crystallization of the gneisses and schists, with the development of pegmatitic material or the injection of such material into the rocks, may be called pegmatization. In many places the process has gone so far that it is very difficult to distinguish pegmatized rock from granite gneiss and especially from flow-banded and porphyritic granite gneiss. This difficulty is due partly to the fact that granite and pegmatite are composed of the same minerals and have no sharp division line between the size of their grains.

The peridotites are dark-green to greenish-black basic rocks, containing one or more of the ferromagnesian minerals olivine, pyroxene, and in places hornblende as chief constituents. So far as known the peridotites of this region are of Archean age and are apparently genetically connected with the Roan gneiss. Though composing but a very small part of the rocks of the monazite belt, the peridotites generally outcrop prominently wherever they occur, and many outcrops are marked by large rounded "nigger-head" boulders scattered over the surface. For the most part the peridotites have altered to talcose or chloritic soapstone or to serpentine. This alteration is, in some places, only superficial, but in others whole masses have been so

metamorphosed. The usual form of occurrence of the peridotites is in lens-shaped bodies parallel, or nearly so, to the schistosity of the inclosing rocks.

Quartz diorite of undetermined age is one of the less important intrusive rocks in the monazite region. It is a fine-textured rock, composed of granular quartz and feldspar with more or less hornblende, locally with garnet distributed promiscuously through it. The occurrence of quartz diorite is generally in small dikes ranging from a few inches up to several feet in thickness. The diminutive size of these dikes, however, is offset by their abundance and resistance to erosion, owing to which they leave much debris over many of their outcrops in the form of hard rounded boulders.

Diabase is the latest intrusive rock known in the region and is probably of Triassic age. It is a dense, hard rock of dark-green to black color, composed chiefly of olivine and a feldspar rich in lime. It is rather abundant in places and the outcrop is generally marked by characteristic spheroidal "nigger-head" boulders scattered over the surface. The diabase dikes range from a few inches up to 100 feet or so in thickness.

Structure.

The regional metamorphism, with accompanying folding and faulting of the rocks in this area has been extreme. In many places, especially in the Carolina gneiss, it is very difficult to determine the original nature of the formations, for much of the sedimentary structure or igneous texture of the rocks has been destroyed by mashing and recrystallization. The Carolina gneiss has been intruded by rocks of later age and cut by them into irregular-shaped masses, many of which fork out into long tongues or occur as narrow streaks in the intrusives, or vice versa. There have been successful intrusions of igneous rocks of later age into the earlier formations. Thus the Carolina gneiss is cut by the Roan gneiss, and both are cut by granites of later age. Many of the granites have included blocks of the formation in which they have been intruded. In places the inclusion has been more or less absorbed by the surrounding granite, the composition of which has thereby been affected. Thus, where masses of hornblende gneiss are included in granite, the latter is generally highly hornblendic in their vicinity.

The structure of the pegmatite in the rocks of this region is extremely irregular. In some places the pegmatite occurs in the form of sheets or lenses interbedded and folded with the inclosing gneisses and schists. In other places it occurs in dikes, veins, or lenses either conformable with the inclosing rocks through part of its extent and cutting across them in other parts, or in irregular masses having no definite orientation with respect to the accompanying formations. In pegmatized rock masses the pegmatization has generally affected certain beds, which may grade into regular pegmatite in either the direction of their greatest or that of their least extension. In such rocks it is often impossible to determine the line of demarcation between the two. There is also a gradation between the pegmatized beds and ordinary gneiss.

Quartz diorite almost invariably occurs in small dikes, in places conformable with the schistosity of the country rock, though elsewhere cutting across it at all angles. The diabase dikes commonly cut across the strike and dip of all the older formations, filling a series of fissures which have a general northwest to north strike.

Weathering and Soils.

The rocks of the Piedmont Plateau have undergone such extensive weathering that good outcrops are the exception, and a thick mantle of residual soil covers much of the country. The variety of rock underlying certain soils can in many places be determined, unless decomposition has been too thorough, by studying the outcrops and graduations from such exposures into the residual soil.

The Carolina gneiss, on partial disintegration and decomposition, commonly forms a gravelly soil with a red clayey matrix. This is especially

characteristic of the garnetiferous and graphite-cyanite types, which are abundant in parts of the monazite region. The pebbles are composed of small fragments of the original rock, such as tufts of cyanite impregnated with hematite or ilmonite, iron-stained garnets, or pieces of hematite. On more complete decomposition a fine reddish clayey soil results, with no decided characteristics. Other types of the Carolina gneiss, in which mica is an important constituent, leave a micaceous soil, much of which assumes a purplish color. Granite and its various phases, on partial disintegration and decomposition, yield light sandy soils. On more complete decomposition the granites yield soils of a light to dark reddish color, depending on the quantity of ferromagnesian minerals, as biotite or hornblende, in the original rock. The quartz grains of the granite remain as sand mixed through a clayey matrix. This quartz sand is almost everywhere to be seen at the immediate surface, from which the clays have been washed by rains. Where Carolina gneiss and granite are intimately associated, or where pegmatization has been extensive in a body of Carolina gneiss, there results a sandy soil, characteristic of granite, through which are scattered pebbles of hematite and ferruginous cyanite, characteristic of the Carolina gneiss. The relative importance of pebbles in such soils decreases as the quantity of pegmatite or of granite in the rock formation increases. These features of the soils are especially marked on the broad, flat ridges characterizing much of the Piedmont Plateau region. The Roan gneiss leaves a greenish sandy soil on disintegration, and an ochre-yellow to dark reddish-brown or chocolate-colored clayey soil on decomposition. Black stains of manganese are associated with many of the soils derived from hornblende rocks.

A clew to the nature of the rock formations in a given region is often furnished by the character of the gravels in the bottom lands and streams draining that region. Thus in this area a very light-colored gravel with much quartz debris indicates a granite or its contact or a very highly pegmatized country rock. Garnets and hematite iron ore, with which blocks of mica or cyanite gneiss are associated, indicate Carolina gneiss. Quantities of black sands in the stream gravels, containing magnetite, ilmenite, hornblende, etc., are characteristic of the Roan gneiss.

OCCURRENCE OF MONAZITE.

Up to the present time the only deposits of monazite successfully worked have been the gravel beds in streams and bottom lands, and in certain places surface soils adjoining rich gravel deposits. Prospecting and careful mill tests on monazite-bearing gneiss and schist have failed to discover deposits of a nature that could be worked extensively. The saprolite or rotted rock underlying some gravel deposits has been washed in small area, with results reported to be favorable.

Placers.

Commercial deposits of monazite in gravel occur in the beds of creeks and streams and the bottom lands along them. The thickness of the gravel ranges from a foot or two, including overburden, to 6 or 8 or more feet. The distribution of the monazite in them is, as with all heavy minerals, richer near the bed rock and poorer above, grading into the overburden. In some deposits the whole bed, with the finer alluvium at the surface, is rich enough to be washed directly or sluiced down and washed. The extent and value of these deposits vary with the topography of the country and the nature of the gravel. The best deposits are more commonly associated with light-colored gravels and sands, containing considerable quartz debris and fragments of other light-colored rocks, such as pegmatite, granite, mica, and cyanite gneiss. On the other hand, the absence of much quartz and pegmatitic or granitic debris from the gravels is generally characteristic of low-grade deposits of monazite. The presence of black sands—magnetite, ilmenite, hornblende, etc.—in the gravels does not necessarily indicate a low-grade deposit, unless quartz and pegmatitic minerals are lacking also.

Residual Deposits.

The surface soils on land adjoining some of the rich monazite deposits have been found to contain sufficient monazite to make sluicing down and concentrating profitable. This is the case to a depth of 3 or 4 inches or more in many residual soils that have suffered but little displacement on the surface, and to depths of several feet where the drift soil has collected on the gentle slopes below a steeper hillside. The partial concentration of monazite in the top layer of soil is caused by the washing away of the clay and other light decomposition products of the rock. The supply of monazite in the stream gravels in favorable areas is often replenished by the wash from the hillside soils during rains. This is especially true where the hills have any considerable slope and the land is cultivated. Under such conditions it is frequently profitable to work the stream gravels two or more times in a year.

The saprolite or rotted rock underlying the richer deposits of monazite is at some places sluiced down to depths of a few inches to a foot or so, along with the overlying gravels. At other places small amounts are removed and washed separately for the monazite they contain. The formations that have been found especially favorable for such work are highly pegmatized gneiss or schist. Such deposits have generally soon been lost or grown poor, probably on account of the fact that the miners have cut through the richer bed or failed to follow it in the direction of its extension. The occurrence of monazite in saprolite will be considered along with the occurrence of monazite in hard rock formations, as the former is merely an altered phase of the latter.

Monazite in Rock Formations.

Two separate companies have, at different times, undertaken to work a deposit of monazite-bearing rock about 3 miles northeast of Shelby, N. C. In each case the undertaking failed, because it was impossible to obtain sufficient ore of the high grade necessary to make the operations a success. At a number of the placer deposits ledges of rock have been found, either in the bed of the streams or near by, which contained monazite in noticeable quantity. So far the rock in which the monazite has been found in noticeable amounts is pegmatized gneiss.

It is possible in many of the mines to pan the saprolitic pegmatized gneiss under the monazite-bearing gravels almost at random and obtain monazite. The amount of the mineral obtained when the panning is done with a long-handled shovel ranges from a few grains to a teaspoonful per shovelful, according to the richness of the beds. Mr. George L. English has kindly furnished the results of a test made by him on the monazite content of the saprolite underlying the gravels at the F. K. McClurde mine, near Carpenter Knob, Cleveland County, N. C. From 30 cubic feet of saprolite 424 grams of concentrates, carrying about 40 per cent of monazite, were obtained by washing in a sluice box. This approximates closely one-third of a pound of pure monazite to a cubic yard of saprolite.

The monazite content of the rock at the deposit 3 miles northeast of Shelby, N. C., has been given a thorough test with a well-equipped mill by the British Monazite Company. The following data are given through the courtesy of Mr. Hugh Stewart, by whom the tests were made. Practically all the rock at the mine, through a vertical height of 15 to 18 feet across the bedding, carried monazite. The quantity in different beds ranged from 0.03 per cent and less up to 1.10 per cent and more. While the mill was in operation all beds carrying 0.4 to 0.5 per cent or more were treated as ore, while lower-grade material was discarded. According to Mr. Stewart, one ore bed with a thickness of about $3\frac{1}{2}$ feet was found to average 1.10 per cent of monazite.

Most of the pegmatized gneiss bodies which are rich in monazite represent phases of the Carolina gneiss in which the original nature of the rock has been largely obliterated as a result of the addition of new minerals and the

recrystallization of the original ores into pegmatitic material. The texture developed during this pegmatization is generally porphyritic, in which the feldspar phenocrysts assume somewhat of an augen form. The feldspar phenocrysts range in size from those smaller than a grain of wheat to those the size of a walnut. The porphyritic gneiss may grade into less or more highly pegmatized gneiss, and from the latter into regular pegmatite. This gradation may be between two separate beds or from one part to another of the same bed. In those beds or portions of beds where there has been little pegmatization monazite occurs sparingly. The same is true where pegmatization has been complete and but little of the original gneiss remains. It is, then, the beds of gneissic rock which are rich in secondary quartz and contain numerous small masses of feldspar throughout that carry the most monazite. In such rocks there is generally much biotite, with graphite and perhaps some muscovite and other accessory minerals, as well as abundant quartz and feldspar. The quartz occurs in layers or scattered grains throughout the rock, inclosing and replacing the other constituents. The feldspar crystals chiefly replace, though they partly displace, the other minerals of the rock. Monazite in a rock matrix almost invariably possesses crystal form, in places having brilliant faces and sharp angles.

As a typical example of rich monazite-bearing rock, that from the British Monazite Company's mine, 3 miles northeast of Shelby, is chosen for de-

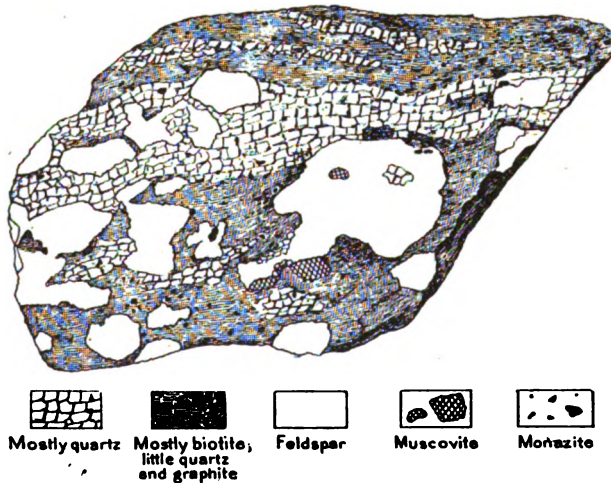


FIGURE 27.—Hand specimen of monazite-bearing rock from British Monazite Company's Mine, 3 miles northeast of Shelby, N. C. Three-fourths natural size.

scription. Fig. 27 represents a section across a hand specimen of this rock and shows the main feature to which attention will be called below. The chief constituents of this rock are quartz, feldspar (mostly the potash variety), biotite, graphite, muscovite, monazite, and a little zircon. It has a banded structure caused by the more or less separate occurrences of certain minerals arranged in parallel streaks, with a roughly parallel orientation of the crystals or grains of each mineral. The principal features of the banding as seen in the section consist of one large quartz streak with several smaller streaks and individual grains in a regular biotite schist. The other minerals of the section occupy various positions and show diverse relations to the minerals of these bands and to each other. The feldspar is porphyritic and occurs chiefly in individual crystals, some of which are of considerable size. A number of the feldspar phenocrysts are small bodies of pegmatite in themselves. As an example, the largest feldspar crystals

shown in the section includes both quartz and muscovite. The feldspar at the lower left-hand side of this crystal also has much quartz and muscovite associated with it. As shown in the section, the feldspar phenocrysts replace the other minerals. This replacement is especially well shown by the interruption, with but little displacement, of the lower biotite band by the large crystal described above. Graphite occurs in large amounts with biotite, though it is associated with nearly every other mineral of the rock. Where present, muscovite is chiefly associated with the feldspar. Monazite seems to be indiscriminately scattered through the rock, included in or associated with all the foregoing minerals. Though generally free from inclusions it is not invariably so, and in one case a plate of graphite was observed within a monazite crystal. All the minerals observed in the rock, with the exception of zircon, have been noted as inclusions in the feldspar phenocrysts.

In microscopic sections cut from specimens from one of the ore streaks, the minerals described above were observed, together with some iron staining. The feldspar is principally orthoclase and microcline, partially kaolinized. The quartz is plainly secondary, and occurs in bands or streaks of grains parallel with the schistosity of the rock. In some places the quartz has been deposited in the fractures or between the grains of other minerals; in others it replaces or includes fragments of such minerals as biotite and graphite.

Gas cavities and inclusions of very fine acicular needles, probably rutile, are abundant in the quartz. Biotite occurs in interwoven laths and crystals roughly parallel to the banding of the rock. The pleochroism of the biotite is light yellow-brown to greenish brown or dark purplish red. Graphite occurs as plates and laths, in general lying parallel to the banding of the rock. Some of it is interbanded and even interleaved with biotite; elsewhere the plates are turned across the foliation. In one section a lath of graphite was observed inclosed in quartz which filled a fracture across the foliation of a biotite crystal. Monazite occurs in contact with the various minerals of the sections, though it is more commonly surrounded by or included in grains of biotite and quartz. The position of the monazite in the biotite indicates replacement, and the biotite foliæ are not displaced around the crystals. In the microscopic sections sufficient feldspar was not observed to determine its relation to the other minerals.

The rock has been so thoroughly recrystallized that it is difficult to give the relative order of formation of the minerals. Biotite, if not still in its original condition, was probably the first mineral to form during recrystallization. Part of the graphite was probably contemporaneous with the biotite. Some, however, was introduced later and formed at the same time with the quartz. The small amount of muscovite in the rock was probably next to form, followed closely by quartz. From the small amount of feldspar in the microscopic sections, it was not possible to state its relative period of formation. From the hand specimen, however, shown in fig. 27, it is evident that the feldspar was introduced later than the quartz, or possibly contemporaneously with part of it.

ORIGIN OF MONAZITE.

Monazite has been observed in pegmatite, pegmatized gneisses and schists, and granite gneiss. The occurrence of monazite in pegmatite is that of an accessory original constituent, with the crystal form more or less well developed. But few occurrences in granites have been observed by the writer, and those were in highly gneissic porphyritic granite. The occurrence in pegmatized gneisses and schists indicates either a gathering together of the proper elements from the original rock and their formation into monazite during recrystallization, or the introduction of the proper elements from external sources, along with the materials causing pegmatization. It is probable that pegmatization in which much quartz with but little feldspar has formed represents a phase of recrystallization, in which the quartz may either, in part or wholly, have come from the original rock itself or may

have been added by solutions passing through the formations. In either case the materials do not represent the work of active magmatic solutions or magmas such as might give rise to regular pegmatite bodies. In those recrystallized or pegmatized rocks where the feldspathic component of pegmatite is not plentiful, monazite occurs but sparingly. On the other hand, monazite is found more abundantly in rock formations in which feldspar plays a prominent part. The common proximity of this form of pegmatization to granite masses gives evidence of its formation through magmatic agencies. Such pegmatized gneisses are probably the result of active magmatic solutions passing through the rock, both aiding in recrystallization of the original constituents, and depositing the materials held in solution when conditions of temperature or agents of precipitation were favorable. As evidence in favor of the association of monazite with the agencies that produce pegmatite may be cited the occurrence of large crystals of that mineral in the pegmatite worked for mica in Mitchell County, N. C.

The monazite of rock formations has, then, probably been derived from aqueo-igneous solutions such as give rise to certain forms of pegmatite and have in these cases affected large masses of rock.

SUMMARY.

The commercial value of monazite is due to the presence in the mineral of a small percentage of thorium. This element forms the basis for the manufacture of various forms of incandescent gas lights. The value of the production of monazite in the United States is small compared to that of other important minerals. Monazite deposits of commercial value have been found within an area of about 3,500 square miles, lying wholly in the Piedmont Plateau region of North and South Carolina. The principal rocks of this region are mica, garnet, cyanite, graphite, hornblende and granite gneisses and schists, massive granite, pegmatite, peridotite, quartz, diorite, and diabase. The structure of the rock formations is complex and in many localities metamorphism has been so extensive that the original nature of the rocks can not be determined. The rocks are in many places concealed by a heavy mantle of residual soil, but their character can often be learned by a study of these soils.

The only deposits of monazite that have been extensively and successfully worked are placers. These deposits are richest in regions where granitic rocks and pegmatized gneisses and schists abound. Residual surface soils and monazite-bearing saprolite are in some places sluiced down from small areas and concentrated. The best known occurrence of monazite in a rock matrix is in porphyritic pegmatized gneiss. In ordinary gneiss and in highly pegmatized gneiss, in which the pegmatite is so abundant that but little of the original rock remains, monazite occurs sparingly. In beds where pegmatization is prominent but not extreme monazite occurs more plentifully. Monazite in pegmatized gneiss is thought to be derived from aqueo-igneous solutions passing through the rock and depositing and recrystallizing portions of it into the minerals of pegmatite.

PRODUCTION.

The production of monazite in North Carolina during the years 1908, 1909, and 1910 amounted to 310,196 pounds, valued at \$37,224 in 1908; 391,068 pounds, valued at \$46,928 in 1909; and 83,454 pounds, valued at \$10,104 in 1910.

In 1910 the production of crude monazite sand in the United States amounted to 254,224 pounds, averaging about twenty-five per cent monazite. The crude concentrates yielded 99,304 pounds of refined

sand, whose value before cleaning was \$12,006. As will be seen from the above, nearly eighty-five per cent of the production of the United States came from North Carolina. The miners were paid a little more than twelve cents a pound for the refined monazite obtained from the crude sand delivered to the cleaning mills, or about three and one-half cents a pound for the crude monazite.

According to the U. S. Bureau of Statistics of the Department of Commerce and Labor, the imports of thorium nitrate for 1909 were but little less than twice as great as the imports for any one of the six preceding years, and the price per pound considerably less. The quantity of thorium nitrate imported in 1910 was the largest yet recorded and the value considerably less. From the above it can readily be seen the reason for the decrease in the domestic production of monazite—the large quantity of monazite and manufactured thorium salts imported steadily increasing and the price for the domestic production steadily decreasing. It is not thought likely that the monazite deposits of the Carolinas will be operated in more than a desultory way while the price of thorium nitrate is kept so low by foreign manufacturers. The present rate of duty (4 cents per pound) on monazite imported into the United States has opened a large market for foreign monazite. The imported monazite is valued at 8.7 cents per pound, but 4 cents duty raises it to 12.7. The price (12 cents per pound) paid to domestic miners for monazite does not include the expense of refining by electric magnetic machinery. In the table below there is given the production and value of monazite mined in North Carolina from 1893 to 1910, inclusive.

PRODUCTION OF MONAZITE IN NORTH
CAROLINA, 1893-1910.

Year	Monazite	
	Pounds	Value
1893.....	130,000	\$ 7,600
1894.....	546,855	36,193
1895.....	1,573,000	137,150
1896.....	30,000	1,500
1897.....	44,000	1,980
1898.....	250,776	13,542
1899.....	350,000	20,000
1900.....	908,000	48,805
1901.....	748,736	59,262
1902.....	802,000	64,160
1903.....	773,000	58,644
1904.....	685,999	79,438
1905.....	894,368	107,324
1906.....	697,275	125,510
1907.....	456,863	54,824
1908.....	310,196	37,224
1909.....	391,038	46,928
1910.....	83,454	10,104

ZIRCON.***PRODUCTION.**

The only year covered by this report in which a production of zircon was made was during the year 1909, when there was a production of about 2,000 pounds of zircon, valued at \$250, from the Jones mine near Zirconia, N. C., operated by Messrs. M. C. & C. F. Toms. In the following table there is given the production and value of zircon mined in North Carolina from 1902 to 1910, inclusive.

PRODUCTION OF ZIRCON IN NORTH
CAROLINA, 1902-1910.

Year	Pounds	Value
1902	2,000	\$ 390
1903	3,000	570
1904	1,070	200
1905	8,000	1,600
1906	1,100	248
1907	204	46
1908		
1909	2,000	250
1910		

TALC AND PYROPHYLLITE.†

Although North Carolina contains many masses of soapstone, most of them are among the mountains with no transportation facilities, and, for this reason, the production of soapstone in the State assumes no commercial importance. On the other hand, however, North Carolina has always been a large producer of talc, the principal active mines in the State being those of the North Carolina Talc and Mining Company, at Hewitt, Swain County; the Alba Mineral Company, near Kinsey, Cherokee County; the American Talc Company, and the Glendon Mining and Manufacturing Company, at Glendon, Moore County.

Talc.—The mine at Hewitt is the largest of its kind in the State and has produced the best grade of commercial talc yet found in this country. In operating the lower portion of this deposit, the work has been greatly handicapped by water. One of the shafts, which had been out of commission for five years, has been reclaimed and operations resumed in it. Five years ago the miners struck a sand stratum in the roof of this shaft and it caved in, the shaft being flooded with the water of the Nantahala River. All efforts to reclaim the shaft proved fruitless until the plan was hit upon of filling the hole with timbers and covering it with cement. With this substantial roof, the matter of clearing out the water became easy. All other shafts on the property are protected by a natural roof of rock.

*See Economic Paper No. 9, pp. 42-45.

†See also Economic Paper No. 3, of the N. C. Geol. Survey.

The Alba Mineral Company, which was more or less active during 1909, did not make any production during 1910, their operations having been interrupted by water. Their talc, however, is of a very promising quality, and, like that at Hewitt, occurs in connection with the Murphy limestone.

Another talc mine owned by the Hewitt Company is located in Graham County, 2 1-2 miles up the Yellow Branch of the Little Tennessee River, the nearest railroad station being Marens on the Tennessee Southern Railway, 9 miles below Bushnell. This property was worked some years ago, but only a small amount of talc was found. The country rock is biotite gneiss, with a large excess of quartz, and, embedded in it are seams of tremolite, much of which has been altered to talc. At the surface it is badly decomposed and little or no good talc was found. At a depth of about 40 feet good talc was encountered, however. It seems to occur in the form of a lens dipping or pitching to the southwest about 45 degrees, an opening from a narrow seam near the surface to a lens 30x40 feet at a depth of 60 feet. A vertical shaft is being sunk, which, at a depth of 65 feet, will be at the lowest level of the old working in the mines, which were opened by means of a shaft and also a tunnel that was started at the level of the brook.

Samples were obtained that had all the outward appearance of tremolite, but the material was pure talc. Masses of talc were found which contained, on breaking them open, small nodules of decomposed tremolite.

An unusual occurrence observed at this mine was crystals of beryl surrounded by the talc, and occasionally masses of galena as large as a man's fist. Garnet was also observed sparingly.

Pyrophyllite. The material mined near Glendon, though it resembles talc, is really pyrophyllite, a hydrous silicate of aluminum that has many of the physical properties of talc and may be used for the same purposes.

PRODUCTION.

The production of talc and pyrophyllite in North Carolina during 1908, 1909, and 1910 were:

For 1908 the production was 3,564 short tons, valued at \$51,443; for 1909 5,956 short tons, valued at \$77,983; for 1910 3,887 short tons, valued at \$69,805. There were seven talc companies producing in the State during 1910. Most of the small producers increased their output, but the production of the principal operators decreased decidedly, so that in the total production of the State there was a falling off of

nearly 35 per cent, or from 5,956 tons in 1909 to 3,877 tons in 1910. These figures for 1910 include both talc and pyrophyllite; there were four producers of pyrophyllite and three of talc. The average price of the talc, including the manufacture of the ground as well as that sold in the rough state at various mines, was over \$17 per ton. The average price of the ground talc per ton was about \$11; that of pyrophyllite was nearly \$10 per ton. As there is very little talc sold in the crude state the values are for the production as it was marketed and it usually represents the manufactured product. In the table below there is given the condition in which the 1907 production was marketed, together with the productions for 1908, 1909, and 1910.

PRODUCTION OF TALC AND PYROPHYLLITE IN NORTH CAROLINA DURING 1907, 1908, 1909 and 1910.

Condition in which Marketed	1907		1908		1909		1910	
	Quantity, Short Tons	Value	Quantity, Short Tons	Value	Quantity, Short Tons	Value	Quantity, Short Tons	Value
Ground talc for powders, etc.....	2,245	\$24,514	2,654	\$25,273	5,601	\$48,499	3,037	\$35,024
Talc cut into pencils, gas tips, etc.	160	43,034	110	23,891	130	28,734	114	31,151
Talc sold crude	1,580	5,999	790	1,989	200	600	576	3,030
Soapstone cut into slabs for chimneys, etc.	100	800	10	300	25	150	100	500
Total.....	4,035	\$74,347	3,564	\$51,443	5,956	\$77,983	3,887	\$69,805

In the following table the quantity and value of talc and soapstone from 1898 to 1910 are given.

PRODUCTION OF TALC AND SOAPSTONE IN NORTH CAROLINA, 1898 TO 1910, INCLUSIVE.

Year	Quantity	Value	Year	Quantity	Value
	Short Tons			Short Tons	
1898.....	1,695	\$ 27,320	1905.....	4,035	\$ 74,940
1899.....	1,817	31,880	1906.....	4,184	66,979
1900.....	4,522	75,303	1907.....	4,035	74,347
1901.....	5,819	77,974	1908.....	3,564	51,443
1902.....	5,239	88,962	1909.....	5,956	77,983
1903.....	5,331	76,984	1910.....	3,887	69,805
1904.....	3,801	65,483			

PRECIOUS STONES.*

During the years 1908, 1909, and 1910 there was little systematic mining for gems in North Carolina, and a number of well-known gem localities were not operated at all. One of the gem minerals for which North Carolina is especially noted is the beryl, and nearly all the gem production during the past three years has been of beryl gems.

*See also Bulletin No. 12 and Economic Papers No. 6, pp. 50-57; No. 9, pp. 55-62; No. 15, pp. 67-74.

BERYL.

Emerald beryl. During 1909 the discovery of a new emerald prospect in North Carolina was made on the land of Mr. W. B. Turner, 4 3-4 miles south 30° west of Shelby, Cleveland County. This locality was described by Mr. Douglas B. Sterrett of the U. S. Geological Survey in his report* for 1909 as follows:

A new emerald locality was brought to light in North Carolina during 1909. It is on the land of W. B. Turner, 4¾ miles S. 30° W. of Shelby, near the east bank of First Broad River, in Cleveland County. It is reported two emeralds were found some fifteen years ago about a mile southeast of Mr. Turner's. Little interest was shown in these emeralds locally, and no further prospecting was carried on for them. Mr. George L. English, then of New York, endeavored to find the locality from which these crystals came, but without success. Through the kindness of Mr. English, now of Shelby, N. C., the writer was informed of the recent discovery of promising crystals of emeralds on the Turner place and a trip to the locality was made in December, 1909. Up to that time some ten or a dozen crystals had been found loose on the surface of the ground. These crystals have a fine dark grass-green color. They are more or less checked, and some contain silky internal markings. The largest emerald found measures about 1 by ¾ by ½ inch. It is about half of a crystal split parallel with the length. The other stones range in size down to about a carat in weight in the rough. Some are nearly whole crystals and others are fragments of crystals. All of them are rather strongly etched and striated. One of the crystals was cut into a faceted stone of less than 2 carats weight and reported to have been valued by the lapidary at \$20. This stone is not one of the best of those found and is rather badly flawed. The majority of the emerald crystals are checked and flawed, but there are portions in some of the crystals that would yield small clear gems of fine color. Minerals associated with the emerald crystals in the soil are colorless and smoky quartz crystals and black tourmaline.

The emeralds found loose in the soil come from an area of about 100 feet by 25 feet on a hillside of moderate slope to the northwest. The slope is toward the river on the west about 150 yards and toward a small stream entering the river at about the same distance on the north. The field in which they were found has been cultivated and the emeralds were exposed by plowing and washing by rains. Crystals of quartz and black tourmaline are found at other points on the surface near the emerald prospects. At a point about 150 yards due northeast these crystals occur rather plentifully. Between these points thin seams or shells of chalcedony were found loose in the soil. At the time of visit no development work had been done, and, as the rock outcrops are few and badly weathered, the geology was not well worked out. The locality is in a rather roughly dissected portion of the Piedmont Plateau such as is generally found along the larger creeks and rivers. The elevation is about 680 feet above sea level, or about 30 feet higher than the First Broad River near by. The higher ridges of the Piedmont Plateau in the neighboring country are about 800 to 850 feet above sea level.

The rocks of this portion of the Piedmont Plateau are principally gneisses and schists, of great age, intruded by masses of granite and diorite. In the vicinity of the emerald prospects the types of rock are varied. There are mica, cyanites, garnet, and hornblende gneisses and schists cut by granite or quartz monzonite, gabbro, diorite, and pegmatite. The trend of the rock formations is to the northeast and east of north near the prospect, and west of north a mile farther in that direction. The dip is generally to the southeast.

*Mineral Resources of the United States for the year 1909, pp. 31-35.

Hornblendic rocks are prominent in the gneisses and schists on each side of the emerald deposit for a distance of a mile or more. These hornblende rocks are, in part at least, metamorphosed phases of the gabbro masses occurring in the region. The gabbro outcrops form large rounded spheroidal boulders of weathering where the rock has not broken down to soil. The granite forms a few ledges of grayish semi-decomposed rock in rather light sandy soil. The gabbro and hornblendic rocks form dark reddish-brown clay soils. The emerald prospect is in a small area of basic rock with granite or monzonite outcrops on either side. Specimens gathered from the surface of the ground consist of gabbro, hornblende or amphibolite after pyroxenite, chloritized amphibolite, and pegmatite. About 20 yards west of the emerald prospect is an outcrop of biotite granite or quartz monzonite. The width of the gabbro belt is over 100 yards, and the rock on the east side is granite or quartz monzonite.

The gabbro outcrops in a few large niggerhead boulders with a grayish-black color and medium grain. Under the microscope the constituent minerals are found to be red-brown hornblende, colorless augite, olivine, bitonite feldspar, biotite, and pyrrhotite. The olivine grains have around them reaction or alteration rims, probably composed of actinolite. The biotite has a strong yellow to reddish-brown pleochroism. The amphibolite was found only in small blocks on the surface and has a greenish-yellow or brown color. The constituent minerals are chiefly pale-brown hornblende with small amounts of augite and iron ores. The hornblende appears to be formed from pyroxene. The chloritized amphibolite has a greenish color and grades into chlorite schist or "soapstone." It is composed of chlorite, green hornblende, actinolite, biotite, iron ores, and small amounts of plagioclase feldspar. The quartz monzonite rock on the west of the prospect is a speckled gray rock of medium grain, composed of quartz, feldspar, and mica, and the field name would be biotite granite. The microscope shows the component minerals to be quartz, andesine feldspar, biotite, muscovite, and a little zircon. The rock should therefore be classed as quartz monzonite.

The gradations from very basic rocks to more acid types in a small area suggest either a basic segregation in the original igneous magma or an inclusion of a basic rock mass in a more acid or granite magma, with an absorption by the latter of part of the former. Results of the latter process are in evidence at numerous localities in the Piedmont Plateau, and the formations of the emerald locality seem to adapt themselves well to this theory. An original mass of gabbro, probably with more basic phases as pyroxenite, was inclosed in a large intrusion of granite magma. The gabbro was broken and blocks of it were floated off and partly or completely absorbed by the granite magma. The latter became more basic near the gabbro mass and graded into it. Thus, rocks ranging from ordinary granite to monzonite, diorite, and gabbro would be formed around the original gabbro. This series may be seen more plainly at other places in the neighborhood. Through the fractures and fissures pegmatitic magmas or solutions passed from the cooling granite into the adjacent rocks, forming pegmatite dikes and veins such as that in which the emeralds have been found.

In April, 1910, and more recently, some prospecting was done at the emerald locality. Mr. English has kindly furnished notes on the results of this work for the following description and loaned a representative collection of wall rock, vein matter, and emeralds for examination. Developments consist of a pit 6 feet deep, a trench 14 feet long started in the hillside to drain the pit, and another trench 25 feet long at a distance of 15 feet northwest of the pit. A pegmatite vein or lens was found, which has a thickness of 30 inches at the surface on the east side of the pit and 18 inches on the west side. In the bottom of the pit the vein has a thickness of about 18 inches on each side. The 25-foot trench was cut to a depth of 3 feet and did not encounter any pegmatite. The vein strikes about N. 70° W. with a dip of 75° N.

The pegmatite is composed of quartz and feldspar, part of which, at least, is albite, with some black tourmaline sprinkled through it and an occasional

emerald or green beryl crystal. The texture of the pegmatite varies from medium-grained to fairly coarse, with nearly pure feldspar and quartz masses 18 inches through. The crystallization is not especially good, though some fairly well developed crystals are found in small rudemiarolitic cavities. Crystals found in the cavities are colorless and smoky quartz, albite feldspar, with sometimes black tourmaline and green beryl. The cavities in the pegmatite are partly filled with reddish-brown, greasy-feeling clay, and the same material, along with limonite stains, has permeated joints and seams through the pegmatite. The feldspar of the pegmatite has partly decomposed in places, so that the rock breaks down rather easily. The emerald crystals found in the vein are smaller than most of those found on the surface and have a much paler color. A considerable number of these beryl crystals were found, ranging from pale emerald green to a fairly dark green. Mr. English washed three washtubfuls of partly decomposed vein material and obtained 34 small crystals and fragments of emerald. There were no emeralds visible in this material before washing. The crystallization of the quartz and feldspar so far found in the pegmatite vein is not so perfect as that in the veins once worked for beryl and hiddenite at Hiddenite, N. C. The albite assumes the form of rough crystals and of aggregations of stout crystals, though not of the clevelandite type common in many gem-bearing pegmatites. The quartz occurs in crystals of average perfection and in many of the specimens exhibits trapezohedral faces indicating a right-hand character. Some of the quartz is nearly colorless and some is smoky colored. One crystal of quartz examined is penetrated by numerous fine light-colored needles, probably actinolite. The emerald crystals are simple hexagonal crystals of beryl with the prism faces and base. Many of them are deeply striated and etched, especially on the prism faces. Other crystals have internal striations or irregularly shaped tubes extending through their length. In some cases these tubes are of considerable size compared with the crystal inclosing them and have been filled with clay or iron stains. The finer tubes appear as silky striations in the crystals. A pretty specimen of emerald in the matrix found in the vein consists of light emerald-green beryl crystal 17 millimeters long and 3 millimeters in diameter embedded in quartz and albite. The emerald is partly embedded in each mineral. The quartz has a light smoky color and is roughly crystallized. The albite also shows rude crystallization and, along with the quartz, is slightly stained with iron. The emerald is transparent, though somewhat checked by flaws. Some of the faces of the prism zone are much striated.

Among the specimens loaned by Mr. English were 16 cut gems. One of these was a faceted table cut stone of 77 milligrams or 0.385 metric carat weight and might be worth from \$5 to \$10. The stone had a flaw in the middle and was light emerald green. The rest of the stones were cut *cabochon* and drop shape and were nearly all dark colored, some of a fine emerald green. All contained checks and flaws or silky striations. The dark-colored stones of this grade might be valued at from \$20 to \$25 per carat. Three drop-shaped emeralds weighed 326, 267, and 251 milligrams, or 1.63, 1.33 and 1.26 metric carats, respectively. These three stones were sufficiently well matched to be used as pendants in a necklace and, though more or less flawed, had a good color. They should be worth at least \$25 a carat. Other gems cut *cabochon* were of better quality, though slightly paler in color than the three drop-shaped stones. Several of the emeralds cut *cabochon* exhibit a fairly good cat's-eye effect along the silky internal striations, very similar to the effect and due to the same cause of the tourmaline cat's-eye from Southern California. The crystal from which the faceted gem was cut was obtained from the pegmatite vein. The other stones with deeper color were cut chiefly from crystals found on or near the surface.

As the prospect pit has been made on the hillside below the point at which some of the emeralds were found and has yielded only gems with a paler color than those found on the surface, it is possible that there is another vein.

Mr. Thomas English, of Spruce Pine, N. C., reports the discovery of a new emerald prospect near the Emerald Matrix mine, on Crabtree Mountain, 4 miles southwest of Spruce Pine, in Mitchell County. The new prospect is about a quarter of a mile north of the old mine and considerably lower down on the side of Crabtree Mountain. Only a few blasts had been put in, and several specimens had been obtained. These crystals are said to have a little paler color than those of the old mine. Some of the emeralds are of pencil thickness though most of them are somewhat checked. The best emerald matrix material is said to be the dark-colored quartz wrapped in scaly biotite.

In the report* for 1910 Mr. Sterrett writes with regard to this locality as follows:

The locality is a hillside of moderate slope about 30 feet higher than the First Broad River near by. The elevation is about 680 feet above sea level. The rocks of the region are principally gneisses and schists of great age intruded by masses of granite and diorite. In the vicinity of the emerald prospect the types of rocks are varied. There are mica, cyanite, garnet, and hornblende gneisses and schists cut by granite or quartz monzonite, gabbro, diorite, amphibolite, and pegmatite. The emerald occurs in pegmatite cutting and amphibolite. The amphibolite is associated with a mass of basic rock which presents two phases, olivine gabbro and diorite. These rocks are in turn inclosed in biotite granite, and the latter rock includes masses and balls of the more basic rocks near the contact of the two. The several rocks are more or less decomposed near the emerald prospect and some phases of the decayed gabbro and amphibolite are difficult to distinguish from one another. The basic rocks make a dark, reddish-brown clay soil on thorough decomposition, and the granite gives a lighter-colored generally sandy soil. Minerals associated with the emeralds are albite, quartz, clear colorless, and smoky, in some cases, with black tourmaline and actinolite inclusions, black tourmaline, and common green beryl crystals.

At the time of the last examination there were 5 openings and 2 small ones that had been filled up. The largest working consisted of a trench over 100 feet long and from 2 to 12 feet in depth. The next largest opening, about 7 feet east of the trench, was a pit 15 feet long, 9 feet deep, and 7 feet wide. All of the workings were within a space of 50 feet and were in an east and west direction from each other. Decomposed and partly chloritized amphibolite and gabbro were encountered in each cut. In the largest trench 4 or 5 pegmatites were cut, most of them being small. Emeralds were found in one pegmatite only, the other pegmatites containing only quartz and tourmaline crystals. Veinlets of quartz crystals with little if any other mineral, cut the amphibolite. Some of the quartz crystals from these veinlets are very clear and measure 2 inches through. Part are colorless and part smoky brown. The pegmatite carrying the emeralds is lens-shaped with irregularities in direction. In the larger pit it was 30 inches wide at the surface on the east side of the pit and 18 inches wide on the west side. At a depth of 10 feet the pegmatite was about 18 inches wide. An offset or over-lapping lens of pegmatite was exposed in the east face of the pit near the surface. The pegmatite has an irregular strike approximating east and west and a dip of 80° N.

The gem-bearing pegmatite is medium to coarse-grained and is composed of quartz and feldspar, part of which, at least, is albite, with some black tourmaline sprinkled through it and an occasional emerald or green beryl crystal. The crystallization of the minerals of the pegmatite is not good, but a few partly developed crystals are found in small irregular miarolitic cavities. Crystals found in these cavities are colorless and smoky quartz, albite feldspar, with black tourmaline and a little beryl. The cavities in the pegmatite are partly filled with reddish brown, greasy-feeling clay, and

*Advance chapter from Mineral Resources of the United States, 1910.

the same material along with limonite stains has permeated joints and seams through the pegmatite. The feldspar of the pegmatite has partly decomposed in places, so that the rock breaks down rather easily. Some of the emerald crystals are firmly attached to other minerals and others are loose and may be obtained by washing the semi-decomposed pegmatite. Many small fragments and crystals of emeralds have been found this way, but up to 1911 only a very few pieces of gem emerald had been found in place in the rock, nearly all the gem material having come from the surface.

Mr. George L. English,* who has assisted Mr. Turner in prospecting for the emeralds, has kindly given the following information on the latest developments at the mine. The main pit has been sunk to a depth of 15 feet on the pegmatite and another pit a few feet to the east has also exposed the "vein." In this pit the pegmatite was about 5 feet wide and had a dip of 15° to 20° to the east. A trench about 10 feet deep and nearly 30 feet east of the main pit has also cut the "vein." Several other prospects on the place have shown the presence of pegmatite but failed to develop emeralds. At one of these, an eighth of a mile southwest of the main locality, an abundance of fine black tourmaline crystals, a little dark green apatite, two unidentified minerals, one a metallic mineral and the other a dark resinous one, and a blue mineral resembling crocidolite were found.

In the main pit a large pocket of emerald crystals was found at a depth of about 10 feet. Most of these were pale colored, but some were nearly equal to the pieces found on the surface. Only a few small pieces have been cut and a faceted stone among these was sold at the rate of \$48 per carat. The largest crystal found measured 2¼ inches long by five-eighths of an inch in diameter, and weighed 26.2 grams. This crystal was broken into four pieces. The color except near the termination is pale and the crystal is deeply striated so that its color does not appear so strong as on broken surfaces. Many of the crystals from this part of the "vein" are opaque inside, but have thin transparent shells of rich green color that would cut into good faceted stones of small size.

Aquamarine and golden beryl. The following notes regarding the Joel Walker aquamarine prospect and the Littlefield aquamarine beryl mine are taken from Mr. Sterrett's report.†

The Joel Walker beryl prospect is on a knob one-half mile east of Walker Knob of the South Mountains, 8 miles west of south of Morganton, Burke County, N. C. Beryl crystals have been found at two places here about 200 yards apart. One of these has been opened by a pit 10 feet deep and 18 feet long. This pit is along a pegmatite body striking north and south with an easterly dip. The country rock is mica gneiss cut by granite and has a northeasterly strike. Black tourmaline and small sheets of mica are associated with the beryl in the pegmatite. Both aquamarine and green and golden beryl were found in this opening. At the other locality numerous small yellow and golden beryls up to the diameter of a pencil in size have been found in bowlders of pegmatite on the mountainside. Some of these crystals are clear and have very rich colors. Much of the beryl observed from these deposits was rather badly checked and flawed, though some crystals were seen that would yield cut gems of about a carat in weight. Larger clear stones are reported to have been found. From the small amount of development the showing seems favorable.

Other beryl prospects have been found in the South Mountains. One prospect, a mile east of the Walker prospect, has yielded crystals of good aquamarine color and three-fourths of an inch in diameter, with portions clear enough for cutting.

*Dated, Shelby, N. C., June 2, 1911.

†Advance chapter from Mineral Resources of the United States for the year 1910.

The Littlefield beryl mine is on the headwaters of Tessentee Creek, 1 mile south of Whiterock Mountain, Macon County, N. C. The last work at this mine was in 1902. The vein was removed by an open cut 135 feet long and from 10 feet deep at the northeast end to 25 feet deep at the southwest end. Another open cut 20 feet long and 10 feet deep, a few feet southwest of the main one, showed that the vein had been offset about six feet to the west. The country rock is biotite granite gneiss, porphyritic in places, and strikes N. 40° E. with a 40° SE. dip. The beryls were found in a pegmatite ledge cutting across the granite gneiss with a strike of N. 40° E. and a dip of 85° SE. The greater part of the pegmatite removed in the open cut varied from 3½ to 5 feet in thickness. At the southwest end of the cut the pegmatite pinches down to 8 inches in thickness. Clear aquamarine, green and golden beryl, ranging from needle-like specimens to three-fourths of an inch in diameter and 2 or more inches in length, was obtained at this mine. These crystals furnished very beautiful gems as well as some good specimen material.

Beryl crystals are found on a ridge near the home of R. E. Brown, 1¼ miles S. 25° E. of the point where Johns Creek and Caney Fork join in Jackson County, N. C. A small pit was opened in search of mica on the outcrop of a partly decomposed pegmatite. About a dozen beryl crystals were found in this pit. The crystals ranged up to nearly 1 inch in diameter and 2 inches in length. Some of them were transparent in places and of a fairly good aquamarine color. If crystals with larger clear portions and of the same color could be found, they would be suitable for gems.

The beryls are found in kaolinizing feldspar, associated with quartz and a little black tourmaline. The country rock is mica gneiss, badly decomposed, with which the pegmatite seems to be conformable. To the west a short distance is a band of staurolite schist, and to the northeast chloritic soapstone.

In 1908 it was reported that the Virginia-Carolina Gem Company, of Shenandoah, Virginia, was carrying on some prospecting work on its aquamarine deposit near Mica, Mitchell County. The mine adjoins the property of the American Gem and Pearl Company and is probably the old Hungerford mine.

THULITE.

Another precious stone that was mined in North Carolina during 1908 to a certain extent was thulite or rose-colored zoisite, which is found in the mica mines associated with feldspar, with which it forms patches and groups of crystals, sometimes radiated. Thulite is found at the Flat Rock mine, and furnishes attractive gems when cut *en cabochon* with the inclosing feldspar.

AMETHYST.

Amethyst has been found at several localities in Macon County, North Carolina, and several prospects in mines have been opened in the valley of Tessentee Creek. Other deposits have been found a few miles southeast of these on the south side of the Blue Ridge.

Of the deposits in the valley of Tessentee Creek, the Connally Mine has been worked by the American Gem and Pearl Company of New York, and the Rhodes Mine by the Passmore Gem Company of Boston. Other amethyst mines in North Carolina are located on the



lands of William Long, John Justice, and J. B. Justice. Below is given a brief description of the Connally Mine and the William Long prospect, taken from the 1910 report of Mr. Douglas B. Sterrett.*

Connally Mine.—The Connally mine is on the north side of the valley, about 2 miles N. 55° E. of the mouth of Tessentee Creek, in Macon County. The workings extend over 100 yards northward up a steep mountain side, from an elevation of about 2,600 feet to nearly 2,800 feet above sea level. They consist of prospect pits and tunnels with irregular stopes. Some of the tunnels are over 100 feet long.

The country rock is garnetiferous mica gneiss cut by fine biotite granite gneiss, in both of which pegmatite occurs. The strike of the gneiss as measured in some of the openings was N. 10° to 35° E. and the dip was almost vertical. The amethyst vein cuts across the gneiss with a strike of N. 40° W. and a vertical dip. Local variations in strike occur where the vein follows irregular contacts between the garnet gneiss and the granite gneiss, which, in these places, form the walls of the vein. In other places the vein lies either in garnet gneiss or in granite gneiss. In most of the openings the vein consists of a single seam with pockets of amethyst crystals at irregular intervals. The pockets are more or less lenticular in shape and range from 1 to 12 inches in thickness, and from a few inches to several feet in length. Many of the pockets are filled with yellowish-red and dark-red clay, though some contain cavities. The amethyst crystals line the walls of the pockets, have become detached and lie loose, or are imbedded in the clay of the pockets. Portions of the vein with the pockets and seams joining them form channels for a small flow of water in wet weather, which probably furnishes the clay of the pockets by decomposing the rock along its course. In one prospect two veins were exposed, cutting decomposed granite gneiss. The granite gneiss along one of these veins was more decomposed and more heavily stained with iron than that adjoining the other. The vein in the decomposed rock contained much yellowish-red clay with some amethysts of a fair color. In the other vein only pale amethystine quartz crystals were found.

Seams of small quartz crystals, sometimes in pockets, branch out from the main vein in places, though no amethysts were observed in them.

The amethyst crystals range from a fraction of an inch to over 2 inches in thickness. Most of them have only a pale amethystine color and some are nearly colorless quartz. The purple color of the amethysts is not uniform throughout the crystals, but is generally richest near the points and is often arranged in layers of varying intensity parallel with the crystal faces. Only a small percentage of the crystals yield very dark purple gem material that will cut into stones weighing several carats.

William Long Prospect.—The William Long prospect is between two prongs of the headwaters of Tessentee Creek, 4½ miles east of its mouth. An open cut 30 feet long in an east and west direction with a maximum depth of 8 feet was made on a vein of amethysts. The country rock is granite. The granite on the north side of the cut is partly altered, somewhat porphyritic biotite granite. The granite on the south side and closely connected with the amethyst vein is badly altered and is pinkish yellow. In a thin section under the microscope the following minerals were observed in this rock: Quartz in irregular grains and veinlets, muscovite, aggregates of fine decomposition products, apparently sericite, replacing original feldspars, and hematite stains. This rock is probably an altered form of the country granite. The amethyst vein is reported to vary from less than an inch to 8 inches in thickness, and to have an east-west strike with a high northerly dip. No work was in progress at the time of examination, and only the

*Advance chapter from Mineral Resources of the United States for the year 1910.

poorer specimens of amethysts were seen on the dump. These consisted of crystals ranging from a fraction of an inch to $1\frac{1}{2}$ inches in thickness. They were mostly pale amethystine in color, though fairly dark-purple crystals are reported to have been found.

Amethyst is reported to have been found on the land of John Justice, about two-thirds of a mile southeast of the Long prospect, and on the land of J. B. Justice, about three-fourths of a mile southwest of the Long prospect.

GARNET.

Garnet for abrasive purposes has been mined in North Carolina and occasionally garnets of gem value have been obtained. The following description of a locality in Burke County from which garnet gems have been recently obtained is taken from Mr. Sterrett's report* for 1910.

Garnet crystals for abrasive purposes and occasional gems have been obtained from a deposit 8 miles in a southeasterly direction from Morganton, along Laurel Creek, Burke County, N. C. They are a calcium free, iron magnesium garnet belonging to the pyrope type. The color is a deep pink to rich wine red, and some good gems especially for carbuncle cuts, have been obtained from them. These garnets occur in slightly graphitic schist, which is both micaceous and cyanitic in places, and is a member of the Carolina gneiss. They are closely associated with a pyroxenite rock and occur in the schist at or near the contact with this rock. The pyroxenite occurs in lenticular and rounded masses of various sizes in the schist. These masses range from less than a foot across up to many yards in thickness. In many cases the pyroxenite has altered to chloritic soapstone to a depth of several feet from the surface. There has been contact action between the pyroxenite and inclosing schists, as shown by the presence of chlorite zones between them.

The garnets occur scattered through or in streaks in the schist, either at the contact with the pyroxenite or at a distance of several feet from it. The garnets range in size from a fraction of an inch to 3 or 4 or more inches in diameter. Many of them, especially those near the surface, have been badly decomposed, and in some cases entirely so, and have passed into reddish-brown earthy masses. The garnets occur in the bedding of the schist which they have forced apart, so that it assumes an augen shape around the crystals. This augen effect is very striking in some cases where small masses of kaolinized feldspar occur in the augen on each side of the garnet.

PRODUCTION.

The values of the productions of precious stones of all kinds in North Carolina for the years 1908, 1909, 1910 respectively are: For 1908 \$570; for 1909 \$479; and for 1910 \$700. These are only approximate figures as it is impossible to obtain absolutely accurate figures regarding the production of precious stones on account of the dealers buying the rough material keeping no record of what has been purchased.

*Advance chapter of Mineral Resources of the United States for 1910.

In the table below is given the production of North Carolina for the years 1900-1910 inclusive.

PRODUCTION OF PRECIOUS STONES IN
NORTH CAROLINA SINCE 1900.

Year	Value
1900.....	\$ 12,020
1901.....	24,245
1902.....	5,300
1903.....	1,525
1904.....	10,000
1905.....	3,350
1906.....	5,000
1907.....	7,580*
1908.....	570*
1909.....	479*
1910.....	700*

*Estimated by U. S. G. S.

MINERAL WATERS.†.

A mineral water is any spring or well water sold as water for table or medicinal use, whether still or carbonated, in bulk or in packages. In collecting statistics for mineral waters it is hard to decide just what should be included as mineral water as distinguished from the natural spring waters sold for mineral purposes. The plan adopted by the U. S. Geological Survey has also been adopted by the State Survey because of the collecting of statistics by the two surveys on a coöperative basis, and is outlined below:‡

"In distinguishing between what to include and what to exclude, a somewhat arbitrary rule was necessary because of the great variety of natural waters, the widely different methods by which they are prepared for market, the many purposes for which they are sold, and of the gradations between strictly natural and strictly artificial waters. In general, the decision was based on commercial rather than scientific grounds, so that although the figures of output include waters that differ widely in mineralization, they do not include any water sold for public supply nor any that is essentially artificial. Hence the statistics cover the output of both natural waters, those bottled just as they flow from spring or well, and of what may be called semi-natural waters; that is, natural waters that have been strengthened by evaporation, treated to prevent the deposition of iron, or carbonated by gas obtained from the spring or well or by gas made artificially. Both the natural and the semi-natural waters fall into two classes, table and medicinal.

"The waters excluded from the tables given in this report are of

†The mineral waters of the State have been described in detail in Economic Paper No. 15, 1908, pp. 74 to 145.

‡United States Geological Survey, Mineral Resources for 1909.

many kinds. They comprise the strictly artificial drinks, both the artificial vichy and seltzer and other artificial table waters and the various proprietary remedies that may be called medicinal waters; all water distributed by public supply systems; and all water furnished free or at a nominal charge to guests at hotels and sanitariums for drinking or bathing. The sweetened beverages or soft drinks are not classed as mineral waters and are of course excluded."

In the report for 1907 there was given analyses and the mineral content of a large number of the mineral springs of the State. Several springs that are now shipping mineral water were not described in the report for 1907 and a brief description of them is given here.

Derita Mineral Springs. This spring is located in Mecklenburg County, near the village of Derita. There are a number of springs on the property, but the chief spring and the one from which the water is shipped is known as Spring No. 2. No quantitative analysis is available of this water, but a qualitative analysis made by Dr. H. B. Battle, shows the water to contain 9 grains of solid matter per gallon, consisting chiefly of calcium sulphate (Ca SO_4). This analysis shows it to be a calcic water. There is also present in much smaller quantities potassium chloride, sodium chloride, magnesium chloride, magnesium sulphate, sodium carbonate and iron oxide.

Sherrill or Sossaman Springs. These springs are situated near Harrisburg, Cabarrus County, and are operated by the N. J. Sherrill Mineral Springs Company of Charlotte, N. C. Spring No. 2 is the one that furnishes the mineral water for shipment. The following analysis made by Mr. E. E. Randolph, of the University of North Carolina, shows the chemical composition of the water:

Calcium Sulphate	20.841
Calcium Bicarbonate	3.175
Iron Carbonate (Ferrous)	6.201
Iron Sulphate	2.010
Sodium Sulphate	4.025
Sodium Chloride	1.172
Potassium Chloride .....	.832
Magnesium Sulphate .....	.017
Silica .....	.121

The total solids in each gallon of water is 38.398 grains. Mr. Randolph states in regard to this water that it is pure "so far as free from albuminoid, ammonia, nitrates and typhoid bacteria are concerned; also free from organic matter."

On account of the distance of this spring from the railroad it has not been developed to the extent that the character of the water justifies, but the owners expect the car line to pass near the spring very shortly, when its production will be largely increased.

Rocky River Springs. These springs—four in number—are situated in Stanly County, seven miles west of Norwood, and twenty miles north of Wadesboro. Hack lines are operated between these points and the Rocky River Springs Hotel. The springs are named according to their predominating or characteristic constituent and are known as the Arsenic Spring, Iron Spring, Sulphur Spring, and Magnesia Spring. Each of these springs is carefully enclosed and well kept. They have been developed and splendid accommodations have been provided for guests in the Rocky River Springs Hotel and Annex. The location is delightful and the place is patronized as a summer resort.

PRODUCTION.

The productions of mineral waters in North Carolina during the years covered by this report are given as follows:

1908.

The North Carolina output of mineral water decreased in 1908 in spite of about 30,000 gallons sold by springs reporting for the first time. The sales were reported as 160,195 gallons, valued at \$27,163 as compared with 193,479 gallons, valued at \$40,302 in 1907, a decline of 17.20 per cent in quantity and 32.6 per cent in value. Four new springs reported a production: Derita Mineral, Lincoln, Sherrill's Mineral, and Smith Mineral, making the total number of springs reporting 18. Nearly 90 per cent of the total output of the State is used for medicinal purposes. Resorts are situated at eleven of the springs, with accommodations for nearly 1,500 people, and at 8 the water is used for bathing purposes. In addition to the sales there were 11,200 gallons used in the manufacture of soft drinks. The 18 springs reporting in 1908 were as follows:

All Healing Spring, Alkalithia Springs, Alexander County.
Barium Rock Spring, Barium Springs, Iredell County.
Buckhorn Lithia Springs, Bullock, Granville County.
Cleveland Springs, near Shelby, Cleveland County.
Derita Mineral Spring, near Charlotte, Mecklenburg County.
Haywood White Sulphur Spring, near Waynesville, Haywood County.
Hot Springs, Hot Springs, Madison County.
Jackson Springs, Jackson Springs, Moore County.
Lincoln Lithia Spring, Lincolnton, Lincoln County.
Mida Spring, near Charlotte, Mecklenburg County.
Moore's Springs, Moore's Springs, Stokes County.
Mount Vernon Springs, Mount Vernon Springs, Chatham County.
Panacea Spring, near Littleton, Warren County.
Seven Springs, Seven Springs, Wayne County.
Sherrill Mineral Spring, near Harrisburg, Cabarrus County.
Sparrow's Spring, Kings Mountain, Cleveland County.
Vade Mecum Spring, Vade Mecum, Stokes County.

1909.

Owing to the smaller number of springs reporting sales during 1909 the output and the value for this year were less than in 1908. The sales reported by spring owners during 1909 amounted to 128,171 gallons, valued at \$20,558, against 160,195 gallons, valued at \$27,163, reported in 1908, a loss of 32,024 gallons, in quantity, and of \$6,605 in value. The average selling price decreased from 17 cents to 16 cents per gallon. Three new springs reported—the Huckleberry, Kuidene, and Rocky River. The total number reporting was 15, or three less than in 1908. Several were idle or out of business, and 2 declined to make returns. The greater part of the water sold is used medicinally. At 9 of the springs are resorts, accommodating nearly 1,500 people, and the water at 2 is used for bathing. Only a small quantity was reported used in the manufacture of soft drinks. The following springs made returns of sales for 1909:

All Healing Springs, Alkalithia Springs, Alexander County.
 Buckhorn Lithia Springs, Bullock, Granville County.
 Derita Mineral Springs, near Derita, Mecklenburg County.
 Hot Springs, Hot Springs, Madison County.
 Huckleberry Springs, Durham, Durham County.
 Jackson Springs, Jackson Springs, Moore County.
 Kuidene Spring, Polk County.
 Mida Spring, near Charlotte, Mecklenburg County.
 Moore's Springs, Moore's Springs, Stokes County.
 Mount Vernon Springs, Mount Vernon Springs, Chatham County.
 Rocky River Springs, Rocky River Springs, Anson County.
 Seven Springs, Seven Springs, Wayne County.
 Sherrill (or Sossaman) Mineral Spring, near Harrisburg, Cabarrus County.
 Smith Lithia Spring, Oxford, Granville County.
 Vade Mecum Spring, Vade Mecum, Stokes County.

1910.

The same number of springs reported for 1910 as for 1909; that is, 15. The sales reported by spring owners amounted to 143,007 gallons, valued at \$21,389, an increase of 14,836 gallons, valued at \$831, as against 128,171 gallons, valued at \$20,558 in 1909.

The following springs made returns of sales for 1910:

All Healing Springs, Alkalithia Springs, Alexander County.
 Buckhorn Lithia Springs, Bullock, Granville County.
 Derita Mineral Spring, near Derita, Mecklenburg County.
 Huckleberry Spring, Durham County.
 Jackson Springs, Jackson Springs, Moore County.
 Mida Springs, near Charlotte, Mecklenburg County.
 Moore's Springs, Moore's Springs, Stokes County.
 Mount Vernon Springs, Mount Vernon Springs, Chatham County.
 Sherrill (or Sossaman) Mineral Spring, near Harrisburg, Cabarrus County.
 Smith Lithia Spring, Oxford, Granville County.
 Vade Mecum Spring, Vade Mecum, Stokes County.

Barium Rock Springs, Barium Springs, Iredell County.
 Haywood White Sulphur Springs, Waynesville, Haywood County.
 Panacea Springs, Littleton, Halifax County.
 Shelby Lithia Springs, Shelby, Cleveland County.

In the following table there is given quantity and value of mineral waters shipped for the years 1901-1910 inclusive.

PRODUCTION OF MINERAL WATERS IN
 NORTH CAROLINA SINCE 1901.

Year	Amount, Gallons	Value
1901.....	375,700	\$ 42,167
1902.....	104,400	18,795
1903.....	83,100	13,035
1904.....	145,800	21,902
1905.....	201,000	38,755
1906.....	153,680	31,413
1907.....	193,479	40,302
1908.....	171,395	27,163
1909.....	128,171	20,558
1910.....	143,007	21,389

GRAPHITE.*

Most of the graphite of North Carolina is of the amorphous variety and the market for it is of necessity limited. The principal use that has been made of it in the past has been for foundry facings. There has been none of this mineral, however, shipped since the year 1907. In the following table there is given the production of graphite from 1901 to 1910, inclusive.

PRODUCTION OF GRAPHITE IN NORTH
 CAROLINA FROM 1901 TO 1910.

Year	Quantity	Value
	<i>Tons</i>	
1901.....	05	\$ 550
1902.....	830	4,300
1903.....	50	248
1904.....	100	525
1905.....	100	475
1906.....	100	475
1907.....	-----	-----
1908.....	-----	-----
1909.....	-----	-----
1910.....	-----	-----

COAL.

No coal production was reported for the years 1908, 1909, and 1910. There are two areas in North Carolina in which coal occurs. Both of these are in the Triassic formation and are of the same geologic

*See description of graphite deposit of North Carolina in Economic Papers No. 6, pp. 68-69 and No. 9, pp. 62-64.

age as the Richmond coal basin of Virginia. The two areas are known as the Deep River and the Dan River fields, being named from the two rivers which drain them.

DAN RIVER FIELDS.

An examination has been recently made by the U. S. Geological Survey of the Dan River District in Stokes and Rockingham counties to determine whether or not it contains any important coal beds. The work was done by Mr. R. W. Stone, who examined all the known prospect pits and had a number of them reopened. It was found that the coal bearing rocks consist of a narrow belt of black slaty shale, which extends from a point just north of the Virginia line southwestward through Leaksville, Madison, and Walnut Cove, to Germanton. It has been thought by those living in the district that these black shales would lead to good coal with depth. This is not warranted by fact, however. At a few places on Dan River in the black shale belt, thin beds of hard semi-anthracite coal have been found. This coal disintegrates very slowly, and consequently should be as thick at the surface as it is underground. Scarcely more than a foot of good coal has been found in any one bed in the district in a distance of thirty miles along the outcrop, a fact which further diminishes the probability of finding thicker beds below the surface.

The black shale is well exposed at the bridge over Dan River half a mile below Leaksville, in the streets of Madison, and in the railroad cut on the county line at the mouth of Carter Creek. But in none of these places does it show any sign of coal. The beds dip to the northwest at angles ranging from 20° to 60° , so that a prospect becomes a slope and in this district all slopes have to contend with a large amount of water.

During the Civil War coal was mined on the Wade plantation three miles above Leaksville and shipped by boat to Danville. Although the coal is semi-anthracite, the bed is so broken up by shale partings and so small in its extent that operations were soon discontinued. Subsequent prospecting on either side of the old pits show that the bed is a small lens and carries only a few inches of coal. More than 50 pits have been dug within three miles of Walnut Cove in search of coal. High grade coal has been found, but it is nowhere more than a few inches in thickness.

A bed of what appears to be soft flaky coal has been found in several places in the vicinity of Walnut Cove. This material is bright black and looks like some form of coal, but it is most likely only coaly shale. Its soft and flaky character seems to be due to crushing that

has produced widespread effects in this region, and it will probably be found in the same soft condition even where it lies at considerable depth. As this coaly shale is of the same character for several miles along the outcrop, there is no reason to suppose that it changes to coal down the dip of the beds where it is under greater cover. Mr. Stone sunk a pit half a mile south of Walnut Cove and found that this bed is at that point more than 10 feet thick. Analyses show that it contains a high percentage of ash and thorough tests prove that it will not burn and therefore has no coal value.

Half way between Walnut Cove and Germanton, several large pits have been dug and some coal has been recovered from a bed of semi-anthracite less than one foot thick. This coal rests on coaly shale, which is so bright and black that it has been mistaken for coal, and which is known in Walnut Cove as the "soft coal vein." It is not coal, however, and there is no reason to believe that it has been changed to coal even where it lies at great depths.

Mr. Stone's conclusion is that there is no reason to expect to find commercial coal beds in the Dan River District. The beds of semi-anthracite found there are only local. They are of small lateral extent and only a few inches thick.

DEEP RIVER FIELDS.

The Deep River Coal Field, which occurs in Moore and Chatham counties, was thoroughly examined by Dr. H. M. Chance, of Philadelphia, in 1884-85, and a very elaborate report was made by him to the North Carolina Department of Agriculture, and published by them in 1885.

As the Survey is constantly receiving inquiries regarding the coal deposits of the State, the conclusions reached by Dr. Chance are given below:

"1. That a bed of coal of good quality free from slate may be considered workable in this district if twenty-two or twenty-four inches thick.

"2. In the area between Farmville and Gulf, a distance of about four and a half miles, two beds of coal exist that may be considered workable; that these beds are not of workable thickness and quality over all of this area, but are subject to the occurrence of deteriorated patches in which the beds are poor and thin; that it is not unlikely that the workable areas are disconnected, that is, the coal may not be continuously workable from one locality to that next adjoining.

"3. That the most promising area seems to be that lying between the openings on the Taylor place and Egypt.

"4. That the disturbances occasioned by trap-dykes and the presence of the dykes are serious impediments to successful mining.

"5. That the coal found in the above described area is often sufficiently good to insure ready sale, but that to make and maintain a reputation that would insure a market it might be necessary to leave untouched those parts of a mine in which the coal was rather more sulphurous or more slaty than the average.

"6. That it will be unsafe to attempt opening any property for mining until it has been thoroughly explored by bore-holes, and the position and extent of trap-dykes, faults and other irregularities thoroughly determined.

"7. That in the above described area the prospects are sufficiently encouraging to warrant a thorough exploration of each individual tract by the landowners.

"8. That in the present state of development the prospect does not justify the present owners in asking nor purchasers in paying for the land a sum much in excess of its value for farming purposes.

"9. That in the area east from Farmville and southwest from Gulf the developments do not justify further expenditures in search for coal. This conclusion is subject to one qualifying exception, namely: If a market could be found for the anthracite coal of the Evans, Gardner and Wilcox places at a price approximating that commanded by Pennsylvania anthracite for domestic use, these coals could be worked, but the margin of profit would be precariously small and the output necessarily limited. To properly mine and prepare these coals for domestic use would require a method of preparation similar to that used in the Pennsylvania anthracite coal field. The coal must be broken, sized, screened, picked for slate and perhaps jigged. The cost would probably exceed three dollars per ton. The coal would not be likely to sell for more than three-fourths the price of Pennsylvania anthracite."

There are many obstacles to the successful mining of this coal, as have been experienced by the several companies which have operated in this district. Attention was called to this by Dr. Chance as follows:

"As knowledge of the obstacles presented by this coal field is of great importance they will be described seriatim in the following order:

- a.—Variations in thickness and quality.
- b.—Faults.
- c.—Trap-dykes.
- d.—Presence of explosive gas—fire-damp.
- e.—Water.
- f.—Spontaneous combustion (?)
- g.—Absence of coal from some areas.

"a.—*Variations in thickness and quality.*—These have already been described. These variations are commonly abrupt, the coal suddenly shrinking to one-half or one-third its normal size, and singularly enough, the ash seems to increase in inverse ratio as if all the impurities found in the bed where three feet thick were also present when the coal measures only one foot. This phenomenon is not peculiar to this coalfield as I have noticed it at several localities in Pennsylvania. Such irregularities will prove fatal to the financial success of any operation unless their existence is known and their limits thoroughly defined in advance of actual mining, for it seems absolutely essential to plan the work in advance with reference to these variations.

"b.—*Faults.*—Rolls and displacements of the coal measuring a few feet were found in the workings at Egypt and Farmville. In mining the coal for the Raleigh Exposition we encountered two local rolls. Extensive developments might disclose the existence of greater dislocations which would materially increase the cost of mining,—however, the faults known to exist, aside from those caused by trap-dykes, would not seriously interfere with successful mining.

"c.—*Trap-dykes.*—At many points the coals are intersected by dykes as shown by the Farmville, Egypt and Gulf workings, and they seem to be the most serious obstacles yet encountered. It seems of the utmost importance that the exact position and extent of these dykes should be determined upon any property before planning its development. This can only be accomplished by a complete system of boreholes dotted over all the area to be worked, as is being done at present by the owners of the Gulf property. This is the only safe method.

"d.—*Fire-damp.*—The presence of fire-damp is proven by the occurrence of several explosions at the Egypt shaft. I am informed that "blowers" of gas were frequently struck. In mining a bed of this (three feet) thickness the presence of gas must increase the cost of mining, for it necessitates the establishment and maintenance of large airways to secure adequate ventilation to dilute and carry off the gas.

"e.—*Water.*—These rocks do not carry very large quantities of water, and it is not likely that heavy pumping machinery would be needed.

"f.—*Spontaneous combustion.*—In the Richmond coalfield great trouble has been caused by what is called spontaneous combustion. Judging from the similarity of the coals it seems possible that this same difficulty may obtain here. While this is a mere supposition, it is one that can not safely be ignored. Mine fires are such serious disas-

ters that every possible precaution should be taken to prevent them, and when there is any reason to suspect the possibility of spontaneous combustion, it seems to anticipate the danger by any possible precautionary measures that can be taken.

"g.—*Absence of coal over certain areas.*—The failure to find the outcrop of the coal between Egypt and the Taylor place and between the latter place and the Gulf workings, and the demonstrated absence of the coal on parts of the Farmville property are sufficient evidence that over some areas the coal is entirely absent. It has not been possible to define the exact limits of such areas. This must be done by the individuals or companies owning or operating each tract. To ignore the existence of such barren areas and to plan developments upon the assumption of a continuous unbroken bed of workable size would be to invite failure, and as such a plan would inevitably be followed by disheartening failures in many if not in every case, it seems necessary to determine the exact limits of such areas in advance of developments and before the coal is actually opened for mining. A complete series of bore-holes is necessary to give this information, and these holes must be located only short distances apart."

As will be seen from the above, even in 1885 there was considerable doubt as to the real commercial value of these coal deposits, and, although one mine was worked for a number of years, it was not profitable mining, and it is very doubtful if, considering the quality of the coal and the many obstacles to be overcome in mining it, whether these narrow seams of coal can be mined at a profit for many years to come.

In the table below is given the coal that has been produced in North Carolina since 1890, when the Cumnock mine was reopened.

COAL PRODUCTION IN NORTH CAROLINA FROM 1890 TO 1910.

Year	Quantity	Year	Quantity
1890.....	10,262	1901.....	12,000
1891.....	20,355	1902.....	23,960
1892.....	6,679	1903.....	17,309
1893.....	17,000	1904.....	7,000
1894.....	16,900	1905.....	1,557
1895.....	24,900	1906.....	-----
1896.....	7,813	1907.....	-----
1897.....	21,280	1908.....	-----
1898.....	11,495	1909.....	-----
1899.....	26,896	1910.....	-----
1900.....	17,734		

PEAT.*

Because of the rather extensive peat deposits existing in Eastern North Carolina, the development of the peat industry continues to be

*See also Economic Paper No. 15, pp. 146-162.

one of interest to this State. In Economic Paper No. 15 there was given a preliminary report on the peat deposits of North Carolina, prepared by Mr. Chas. A. Davis of the U. S. Geological Survey. While nothing new has developed in regard to the peat industry in North Carolina since the publication was issued, it will probably be of value to those interested in the development of peat to have Mr. Davis' report recently published by the U. S. Geological Survey in regard to the development of the peat industry, which is given below.

NOTES ON PEAT INDUSTRY.*

BY CHARLES A. DAVIS.

Noteworthy progress was made in 1910 in the production of peat fuel in other countries than the United States, not only in the quantity actually marketed but also in methods of production and utilization. In the United States, although it is generally known that there are large quantities of material good for fuel in the peat bogs and swamps of the northern and eastern parts of the country, but little progress has been made in developing this resource on a commercial scale.

Earnest efforts to do this have been made in many places through a long series of years, however, and as failure to get satisfactory returns may be attributed more to ignorance of European progress and methods than to any other one cause, it is thought that a brief summary of the progress already noted may be of value to the owners of peat lands and to others interested in peat utilization in the United States.

Peat must be dried.—Peat must be dried to be successfully used as fuel, because the raw material in undrained deposits has a water content of 85 to 95 per cent or more so closely associated with it that the moisture can only be reduced to a usable degree by evaporation. This larger percentage of water must be dug and be manipulated with the peat to separate from it the relatively small quantity of finished product obtainable, for which only a low price can be expected, because coal and other satisfactory fuels already supply the fuel markets.

Peat must be reduced in bulk and increased in density.—If it is to be used as fuel in furnaces of the ordinary patterns, peat must not only be dried, but it must also be reduced in bulk and increased in density. This is most quickly and cheaply done by grinding to a pulp the wet raw material in machines designed for the purpose. This treatment destroys the fibers and other plant remains in the peat, compacts it, hastens drying, and makes it less friable and brittle when dry. Drying is most certainly and cheaply done by exposing the peat pulp in the form of bricks to the air without application of artificial heat.

Storing.—After thorough drying peat fuel that has been treated as described may at moderate cost be transported, stored, and used at places reasonably remote from points of production.

Erroneous Methods.—This brief statement serves to epitomize the essentials of the production of peat fuel for domestic use and for the usual forms of power generators. It may be added, however, that millions of dollars in the aggregate have been spent in trying to devise ways to take the wet raw material as it lies in the bog and, by mechanical plants and artificially generated heat, to dry and compact it in a series of operations lasting but a few minutes. These devices have included machinery for de-watering the peat by great direct pressure, by filter presses, by centrifugal machines, by electrical treatment, and by combinations of two or more of these methods. Numerous forms of driers using direct heat or steam heat, either specially

* Advance chapter from Mineral Resources of the United States, U. S. Geol. Survey, 1910.

generated or derived from the exhaust from machinery used primarily for other purposes, have been built for drying peat. None of these mechanical plants have been successful, and a thorough analysis of the probable cost of operation as compared with a safe estimate of the selling price of the product would have shown at the outset that such complicated plans were likely to prove unsafe investments.

At the time when European engineers were so successful in commercializing the production of fuel briquets from lignites and coal mine refuse, many attempts were made to produce briquets from peat by methods identical with or similar to those in use for briquetting lignite. In general these attempts were unsuccessful although at least two factories of good capacity were reported to be producing peat briquets commercially in Germany quite recently.

In this brief review it is not possible to summarize all of the plans proposed for making peat into fuel, nor to mention the many complicated and expensive types of machinery that have been designed and constructed for drying and reducing peat to powder in order that equally complex machines might shape it into compact and pleasing forms.

TENDENCY OF EUROPEAN PROGRESS IN PRODUCTION OF PEAT.

The present tendency in the production and use of peat fuel in Europe is towards simplicity. The development and use of elaborate and costly plants is no longer attempted, and the simplest practicable product that can be used efficiently is sought and made. The simplification of processes for making peat fuel has extended to the development of machinery to decrease the employment of hand labor, which, even in regions where laborers are numerous and can be hired at low wages, has hitherto been a source of high cost of production and of restricted output.

The real progress, that which has been demonstrated in plants of commercial size, may therefore be classified under two general heads—methods of increasing production of the fuel itself and methods of deriving more power from the fuel in proportion to the quantity used—that is, of increasing its efficiency. The two lines of progress noted are evidently interdependent, because so long as production is limited, from any cause, use must be limited also. On the other hand, if there is restricted use for any reason, unrestricted production will soon overstock the market and become unprofitable.

Gas Producers and Gas Engines.—For several years past reports of the successful use of peat fuel in gas producers of several types have been published and in this use, apparently, the greatest progress has been made in utilizing peat fuel as a source of power of great possibilities.

It now seems demonstrated beyond any reasonable doubt that gas engines of the explosive type consuming producer gas may be used with entire success for generating power in any quantity that may be needed. Such engines can be run with high efficiency when supplied with gas of very low heat value, generated from fuels of grades that could not be used as fuel for steam boiler firing, if the gas is furnished to the gas engines in right quantity and is of fairly uniform chemical composition. Moreover, the individual gas engine has been increased in size until it is now comparable in horsepower developed with the largest steam engines.

Gas producer plants of large capacity generating power or fuel gas are much more frequent in European countries than in the United States, although in this country both gas engine and gas producer are replacing the steam engine and boiler to a surprising extent in many types of plants.

The gas producer is essentially a vertical furnace in which a part of the fuel, in a very thick fuel bed, is entirely consumed by combining its combustible elements with the oxygen of a carefully controlled supply of air to develop heat enough to convert the rest of the fuel into free hydrogen and carbon compounds which can be still further made to combine with oxygen with the liberation of heat.

The gas thus developed is called producer gas and is, essentially, a mix-

ture of gases, of which hydrogen and carbon monoxide are the important fuel constituents, and nitrogen from the introduced air and carbon dioxide the diluents.

Sulphate of Ammonia.—In addition there are various solid and liquid impurities derived from the fuel during the generating process, which must be removed by washing the gas before it can be used profitably in gas engines; this cleansing is not needed if the gas is used as fuel. Among the substances present in producer gas as it leaves the generator are some which have commercial value. The most readily salable of these is ammonia, which is derived from the combined nitrogen originally contained in the fuel. This may profitably be recovered and fixed as sulphate of ammonia if the quantity of gas generated is large enough to warrant the cost of installing and operating the special form of apparatus needed for the processes involved in combining the ammonia present in the producer gas with sulphuric acid and for the subsequent concentration and purification of the salt on a large scale. The recovery of ammonia as a by-product of gas-producer plant has not generally been found profitable where the capacity was less than 1,000 horsepower, and then only in special forms of gas producers from types of fuel unusually rich in combined nitrogen.

The Mond Gas Producer.—The principle that ammonia could be profitably recovered during the gasification of low-grade bituminous coals in gas producers was first demonstrated by Dr. Ludwig Mond, who embodied his researches in the special form of gas producer which bears his name. Since this was done nearly a hundred plants in various parts of the world have been equipped with the Mond gas producer, although all are not equipped to recover ammonia. At least one of these plants has a rated capacity of 30,000 horsepower and consumes more than 300 tons of coal daily, and others are of large size. The gas generated in these producer-gas plants is used for almost every purpose for which power and fuel are needed in quantity.

These statements become significant when to them is added a recent announcement by the manufacturers of the Mond gas producers, who have so fully demonstrated the use and value of producer gas for power and fuel. In this announcement they report the facts that they have perfected a type of gas-producer and ammonia-recovery apparatus for gasifying peat and that after several years of experimentation, they now have in operation three fully equipped commercial plants which successfully use for fuel peat containing as high as 60 to 70 per cent of water. The report further states that from the gas obtained in these plants sulphate of ammonia has been obtained in quantities ranging from 70 pounds per ton of theoretically dried peat gasified, when the peat had 1 per cent of combined nitrogen, to more than 200 pounds per ton when the nitrogen content was 2.3 per cent. The report continues with the statement that, when such plants are carefully managed—

"So great are the profits obtainable that it is often possible, while taking no credit whatever for the value of the power gas, to obtain as much as 100 per cent profit from sulphate of ammonia alone, after making proper allowance for the cost of digging the peat, bringing it to the plant, and for labor, stores, capital, shares, etc. Indeed, with peats comparatively poor in nitrogen, it is possible in many cases to produce the gas for nothing, the cost of power being then merely that of operating the gas engines, together with capital charges on the same."

Although these claims may be somewhat optimistic, it is clear that if each ton of theoretically dry peat gasified yields from 75,000 to 90,000 cubic feet of producer gas, the calorific value of which is from 125 to 135 British thermal units per cubic foot, and also gives 200 pounds of sulphate of ammonia as a by-product, the operation of a plant consuming 10 tons of dry fuel per day would produce a ton of the ammonia salt. The price of sulphate of ammonia has for some years remained very uniform at about \$60 per ton in spite of enormously increased production.

That this process is of practical application in the United States and should be investigated carefully by owners of peat lands is further indicated

by the composition of some American peats. These often are rich in combined nitrogen, as is shown by the following: In a series of 20 analyses of samples of Ohio peats, made by the Bureau of Mines, the average content of combined nitrogen, on the water-free basis, was 2.79 per cent, the highest of the series having 3.39 per cent and the lowest 2.22 per cent. It must be kept in mind, however, that there are many types of peat in this country and that some of them contain much less nitrogen than the average given for the Ohio peat analyses.

Peat as a Fuel in Large Power Plants.—The possibility of using peat as fuel in large power plants is much increased by the fact that it can be used with as much as 60 to 70 per cent moisture in the Mond producers, and the assurance that this has been done on a large commercial scale is a very important advance. Hitherto it has been stated that the difficulty of drying peat so that it became efficient fuel made its use in large plants so hazardous that few have been willing to try it. If it can be used in the gas producer when it contains as much as 60 per cent water it will be possible, if necessity should arise, to dig the raw material even during the winter, and by pressure alone to remove nearly enough water to make the material thus obtained serviceable in the gas producer.

The process described is practically very similar to that of the German chemists, Frank and Caro, and from these inventors comes also the positive statement of the entire success of their plans which have been embodied in one or more large commercial electric power stations in Germany, located on peat bogs of large area.

It seems probable, therefore, that within a short time, if these commercial operations are as successful as described, peat will be more widely used as fuel than ever before, and that it may come into use in many parts of the United States where swamps and bogs are common.

Powdered Peat at Back, Sweden.—During the year 1910 reports have been published from conservative and reliable sources that at Back, Sweden, the long-continued work of Lieut. H. Ekelund has at last culminated in the successful commercial production of dry powdered peat for fuel, and in a practical method of using the material for generating heat for making steam.

The method used to prepare the raw wet peat is radically different from that used in the United States to produce peat fertilizer filler, a very similar product. At Back the peat is dug by a mechanical excavator, designed especially for digging peat. The peat is macerated and the wet pulp is spread on the bog surface and partly dried. When dry enough to store without deterioration—that is, when it contains less than about 60 per cent of water—the powdered peat is gathered and stored under cover, enough being thus prepared during the short northern summer of Sweden to supply the rest of the plant with raw material for the entire year. This stored peat, as needed, is ground into powder, screened to give uniform size to the dust, and dried by artificial heat in a type of drier invented for the purpose until it contains about 15 per cent of moisture. It is then packed in waterproof bags for storage or shipment.

The statement has been published, as the result of carefully supervised tests, that peat powder made by this method from pure peat, and burned in the way developed by the inventor, is nearly or quite as efficient a fuel as equal weights of good English coal, and that it can be made in the inland districts of Sweden at less than the cost of coal at the same places.

Aside from the value of the type of peat fuel thus produced, the mechanical devices which have been developed at Back for digging, spreading, and handling peat fuel on a large scale, both in the field and in the factory, seem so successful that they may be noted as marking real progress in the difficult matter of insuring large and certain production of peat fuel for any purpose for which it may be required. This peat-powder factory is equipped to produce 10,000 metric tons per year of powdered fuel containing 15 per cent of moisture, and the actual cost of production, ascertained from tests reported to the Swedish Government and including all charges for interest, operation, etc., is said to be about \$2.30 per ton as a high estimate.

As powdered coal has been used successfully in a number of important industries for many years and as powdered peat is now being produced in the United States for fertilizer uses, the work of Ekelund is of special interest. If powdered peat can replace powdered coal in the industries in which the latter material is used for fuel, there are, without doubt, many localities in the United States where the industries using powdered fuel could be established, to which coal could not be cheaply transported. This, as well as several uses to which peat powder is put or can be put in this country, make a thorough investigation of Ekelund's method of producing it of special interest and importance.

Cost of Labor.—It has been very generally said by those who have studied the methods of making peat fuel in use in Europe that these could not be introduced into the United States because labor is so much more costly here than in the peat-producing countries of Europe. This statement has been so often reiterated that it has almost the standing of an economic law. Its force has been so felt that it may be said that because of it no really well directed efforts have been made in the United States to manufacture machine peat, which is the form of peat fuel successfully made in Europe, by closely following the procedure in vogue and thoroughly proved abroad. Instead of testing these methods, a total of hundreds of thousands of dollars has been spent in trying "new and improved" plans and devices for making peat fuel, with only failure in the end.

It has been the contention of the writer that until the facts were determined by actual tests, under favorable conditions of equipment, location, supervision, and capitalization, the question of successful introduction of the best foreign machinery and methods was, at least, an open one. This position was amply confirmed by the success of the demonstration peat-fuel plant* of the Canada department of mines located near Alfred, Ontario, about 45 miles from Ottawa. This was equipped with Swedish machinery of standard make, the reliability of which had been fully proved by commercial use in many parts of Europe.

The operations involved in producing a good quality of air-dried machine peat were carried on exactly as in Europe, including digging the raw peat and turning and gathering the dried product, by hand labor. The other processes were mechanical, the entire plant being driven by a single portable steam engine located at the working opening in their bog and using refuse peat and wood as fuel. The laborers were paid wages equal to those paid in the United States for similar work, and the cost of production per ton of salable material, based on the operation of the plant an entire season of 140 days, at the rate of production attained in 1910, the first year it was operated, was as follows:

COST OF AIR-DRIED MACHINE PEAT AT ALFRED, CANADA.

Cost per ton, on the field.....	\$1.40
Cost per ton, stored in shed.....	1.65
Cost per ton, loaded in cars.....	1.65
Cost per ton, in stack.....	1.70

These cost figures are official; they include interest on capital, amortization, oil, and repair charges, and are derived from the actual production of 1,600 tons of salable material. The actual cost of production for fuel, labor, etc., was about \$1 per ton. The output of the plant could have been doubled by operating night and day, and could also have been increased by lengthening the season of operation. On the assumption that 2 tons of this air-dried machine peat are only equal to 1 ton of anthracite—which is a very low valuation, as peat fuel frequently has a fuel value exceeding 9,000 British thermal units per pound and anthracite seldom has more than 13,500 British thermal units per pound—it would still be possible to produce peat fuel and sell it at a profit, while giving full heating value, in those parts of the United

*Bull. Canada Dept. Mines, Mines Branch, No. 4, 2d Ed., Ottawa, Canada, 1910.

States where peat is abundant, if it can be made at the prices reported from this Canadian fuel plant.

Conclusions.—The conclusion to be drawn from this consideration of the facts presented seems plain: It is possible to make a commercial success of the production of machine peat under economic conditions similar to those existing in many parts of the United States by using European machinery and methods. To insure this success, however, the equipment must be carefully selected, sufficient capital fully to equip and support the enterprise must be supplied, and it must be managed by a man thoroughly familiar by training and experience with this work.

If the successful season's work of the Canadian demonstration plant is repeated in following years, its success for 1910 will be considered the most important event in peat-fuel production achieved up to that time in North America. It should be understood, however, that, while the success of this plant seemingly points to success in the adoption of the same methods and similar machinery in the United States, it does not preclude making changes in either machinery or methods which will fit them more exactly to economic conditions existing here after machinery or methods have been given a trial and found insufficient.

The point demonstrated, however, seems clear, that peat fuel of good efficiency can be made at a profit without adopting other methods or machinery. Hand digging, for example, although employed at Alfred, is not essentially a part of the success of the operations there; in fact, one of the changes contemplated for the immediate future in the equipment of the plant is the substitution of a mechanical excavator to dig the raw peat from the bog.

Peat-digging Machinery.—In those parts of Europe where peat fuel is made in largest quantities for power production, machinery for digging peat is being developed and tested in commercial plants. During the season of 1910 several patterns of mechanical excavators were given thorough tests at plants working under commercial conditions and were pronounced satisfactory; and these can now be purchased. The essentials of such a mechanical digger are that it shall be of light but very strong build, and that it shall leave the walls of the openings made in the peat with such a slope that breaking down and slumping into the holes is avoided as much as possible, as this makes future work difficult or impossible. It is necessary, also, that the capacity of the digging machinery shall be large and that the cost of operation in power and labor shall be low. One such machine was reported at the end of 1910 to have dug the equivalent of 8 tons of salable peat fuel per hour, requiring but one man more than the number usually needed to operate the engine and machinery used where hand digging is in use; eight or ten men were displaced by this device.

The appearance of such a machine in any country must be considered a distinct advance, and one that may make easier and simpler the development of the peat resources of the United States because it removes the bugbear of "too much hand labor."

For several years past in Oldenburg, Germany, a mechanical peat-fuel plant has been in operation. This consists of simple but effective digging, pulping, and spreading machinery, the engine to run it all being mounted on a platform mounted on trucks which run on rails placed on the surface of the bog. A gasoline engine furnishes the power for all of the machinery and moves the plant forward or backward on the tramway; and but a single man is needed to operate the entire plant. The peat is laid out on the cleared surface of the bog in the form of bricks on the opposite side of the tramway from that on which the digging is done, and is thereafter turned and gathered by hand.

Two types of automatic, self-propelling mechanical plants were developed in North America in 1910, one in the United States and one in Canada. These differed from the German model in many details, but especially in the fact that no rails were needed to support them on the bog surface. Both of the new plants were equipped with a form of movable platform sometimes used on agricultural machinery under the name "caterpillar tracking." These

platforms are endless belts of narrow planks linked together by strong chains and passing over the broad supporting wheels, so that they are moved forward with the machine and at the same time give it adequate support on the soft substratum of the peat bog.

In these combined plants the peat is dug, elevated, macerated, spread, and marked automatically, and the amount of manual labor and the number of men employed as compared with older plants is greatly decreased. Either electricity, steam, or gasoline motors may be used in such plants, and but one or two men are needed to operate them, although their output may be very large.

These devices are still in the process of development, but their performance during 1910 was sufficiently good to show that they promise real advancement in the production of peat fuel for all purposes when they are perfected.

The only peat-fuel plant erected in the United States in 1910 was that of the Peat Products Co., at Lakeville, Ind. This plant, however, was not fully equipped until after the end of the year. It is described as a plant in which the peat is dug by the use of a centrifugal pump, pumped to storage bins, and after some of the water has drained away, dried in a special drier heated by exhaust steam and stack gases. When dry, the peat is reduced to powder, conveyed to a briquetting press, and compressed into compact briquets. The machinery used is all of novel design and is automatic in action.

STONE.†

The production of building stone in North Carolina during the past twelve years showed a decided increase up to and through the year 1907, when the largest production yet reported was made. During the year 1908, however, there was a falling off as compared with 1907, when the value of the stone quarried in the State amounted to \$824,927. In 1909 the value of the stone quarried amounted to \$850,807, and during 1910 there was a decided increase as compared with the two previous years when the stone quarried amounted to \$920,027.

There is given in the table below the value of the production of various stones produced in North Carolina for the years 1900 to 1910, inclusive.

PRODUCTION OF BUILDING STONES IN NORTH CAROLINA, 1900-1910.

Year	Granite	Sandstone	Marble and Limestone	Total Value
	<i>Value</i>	<i>Value</i>	<i>Value</i>	
1900.....	\$ 257,962	\$ 27,210	\$*	\$ 285,172
1901.....	264,966	11,682	8,357	284,945
1902.....	338,749	4,825	23,153	366,727
1903.....	334,357	600	25,365	360,322
1904.....	292,439	250	19,887	312,576
1905.....	564,425	4,482	29,015	597,922
1906.....	778,810	3,431	72,051	854,301
1907.....	903,476	4,105	46,338	954,919
1908.....	771,522	..	53,405	824,927
1909.....	743,876	..	103,931	850,807
1910.....	837,742	..	77,585	920,027

*Statistics not collected for 1900.

**Included in total production.

†See Bull. 2 of the N. C. Geol. and Econ. Survey.

GRANITE.

PRODUCTION.

1908.—The production of granite during the year 1908 amounted to \$764,272, a decrease of \$142,204 when compared with the 1907 production of \$906,476.

1909.—The production of granite during 1909 was valued at \$743,876, a decrease of \$20,396 when compared with the 1908 production of \$764,272.

1910.—The production of 1910 was valued at \$839,742, an increase of \$95,866 when compared with the 1909 production of \$743,876. The number of operators quarrying granite during 1910 was 34. These operators worked 35 quarries in the following 15 counties, which are given in the order of the importance of their production: Rowan, Surry, Warren, Rockingham, Buncombe, Polk, Vance, Mecklenburg, Wake, Anson, Davie, Gaston, McDowell, Wilson, and Henderson.

Not quite a third of the granite produced during 1910 was used for building and monumental purposes, amounting to \$268,372. There is given in the following table the use and value of granite quarried from 1906 to 1910, inclusive.

USES OF GRANITE PRODUCED IN NORTH CAROLINA IN 1906-1910.

Uses	1906	1907	1908	1909	1910
Building and monumental purposes.....	\$ 375,074	\$ 432,913	\$ 330,836	\$ 249,511	\$ 268,372
Paving blocks.....	33,428	65,379	122,488	214,508	164,265
Curbing and flagging.....	138,090	66,967	107,328	99,386	113,778
Crushed stone for road making, railroad ballast, etc.....	228,429	336,657	153,749	78,605	291,327
Other purposes.....	3,798	4,580	49,871*	101,866*	2,000
Total value.....	\$ 778,819	\$ 906,476	\$ 764,272	\$ 743,876	\$ 839,742

*Principally for concrete.

The next table gives the value of the granite produced from 1897 to 1910, inclusive, which shows very strikingly the remarkable growth of this industry in North Carolina. The greatest production yet made was during the year 1907 and during the years 1908 and 1909 there was a considerable decrease, but in 1910 the figures again began to go up.

PRODUCTION OF GRANITE IN NORTH CAROLINA, 1897 TO 1910.

Year	Value	Year	Value
1897.....	\$ 59,236	1904.....	\$ 292,439
1898.....	79,969	1905.....	564,425
1899.....	225,544	1906.....	778,819
1900.....	257,962	1907.....	906,476
1901.....	264,906	1908.....	764,272
1902.....	338,749	1909.....	743,876
1903.....	334,357	1910.....	839,742

SANDSTONE.

PRODUCTION.

For the past three years there has been but little change in the sandstone industry in North Carolina. But one quarry has been worked and for this reason we are unable to give figures relating to the production. The production of sandstone is given in the table giving the total production of building stones in North Carolina.

MARBLE AND OTHER FORMS OF LIMESTONE.

MARBLE.

The Geological Survey has received during the past few years a number of specimens of marble from various localities in the western part of the State, some of which show considerable promise of developing into commercial deposits. Mr. Arthur Keith, of the U. S. Geological Survey, in the Nantahala Folio No. 143 of the Geological Atlas of the United States, gives a description of some of the marbles of the Nantahala Area, which is given below:

One of the most important rocks having commercial value in this district is marble. It covers many square miles, as represented on the geologic map, and it outcrops along two principal lines. The main one begins on Nantahala River below Hewitts and extends southwestward to and down Valley River a distance of over 25 miles. A shorter and parallel band extends from the head of Peachtree Creek nearly 10 miles southwestward and up Little Brasstown Creek. The latter of these two belts terminates a few miles west of this quadrangle, but the principal belt extends through Cherokee County and many miles into Georgia, being nearly continuous with the marble belt of that State. Through most of its extent the marble is tilted up at a considerable angle and its outcrop forms only a narrow band. On Peachtree Creek, however, and on Valley River between Marble and Valletown the dips are less and the marble spreads out over considerable areas.

Color and Grain.—The marble has two principal colors—white and blue. Both of these are seen throughout the range of the formation, but the blue and bluish colors predominate toward the northeast. Very little of the blue stone has a uniform color; usually it is more or less banded or mottled with white. Where the marble beds are on edge or have a high dip the banding of color is more regular than in other places. There is also a banding due to lines of foreign minerals. This is best seen in the quarry a mile northeast of Andrews and is caused by lines of mica flakes. An exceptional color, and one of great beauty, is the rose pink which is seen just northeast of Red Marble Gap. This merges into white beds, and the amount of the pink stone is limited. The distribution of the colors of the marble can not be given in detail, on account of the few natural exposures and the few quarries which have been started. What is probably the largest body of white marble is in the bottom lands of Valley River below Andrews.

The grain of the marble is in all cases uniform and fine. It does not appear to be changed by the transition from one color band to another. Probably the grain of the rock is a little coarser toward the southwest, but the difference is very slight. Where the rock is composed of pure carbonates there is practically no tendency to part along the original sedimentary layers. Thin layers of micaceous minerals cause a slight schistosity where they are developed. This is not sufficient to affect the strength of the

quarrying of the rock. Some of the upper layers next to the Andrews schist have more of the secondary minerals where the transition takes place between the two formations. This does not affect the marble as a whole. Northeast of Red Marble Gap similar transitions are seen at the base of the marble, and there is considerable development of micaceous minerals. This causes a decided schistosity, which, however, is limited to the few feet of interbedded marbles and slates. With these exceptions the marble is a uniform and massive rock, and blocks which have been sawed across the bedding planes show no indications of parting in those planes.

Composition.—The chief variations in the composition of the marble are in the proportions of the carbonates of lime and magnesia. These have no particular bearing upon the value of the rock, as they do not affect its strength, durability, or density. The lime varies from 53 to 32 per cent and the magnesia from 2 to 20 per cent. Other variations are due to the varying amount of the included minerals. These are talc, muscovite, biotite, tremolite, ottrelite, garnet, pyrite, and quartz. The amount of quartz varies. From 1 to 2 per cent is present in practically all the beds. The micas are practically confined to the uppermost and lowest layers of the formation. The tremolite and talc are concentrated into lenticular deposits and do not affect the workings of the marble as a whole. Certain other layers contain tremolite crystals, as seen in the quarry on Marble Creek at the border of the quadrangle. The pyrite and garnet are found at a number of places in the lower layers of the formation, but are comparatively rare. In short, the minerals which would injure the working and appearance of the stone are very slight in amount and easily avoided.

During the metamorphism of the marble the carbonate crystals were formed interlocking with one another. This has produced a rock of great density and closeness of texture. Tests of marble from Hewitts, on Nantahala River, show that it is not liable to be acted upon by frost or solution. Four samples of rock from this locality gave an average crushing strength of about 11,000 pounds per square inch.

Thickness.—The total thickness of the marble beds is about 500 feet. The only obtainable measurements are in the southwestern end of the main marble belt. In the broader areas underlain by the formation the different layers have been repeated by folding. Since the beds do not part along the original sedimentary planes, the effect of the thickening has been to increase the marble available for quarrying. Northeast of Valletown the marble is bounded for the most part by fault planes; thus it varies much in thickness, and in places is entirely absent. Along Nantahala River the entire marble bed is present in many places, but appears to have been somewhat squeezed and thinned during the process of folding. Good measurements of its thickness in the vicinity of Hewitts give scarcely more than 150 feet. Below Hewitts the bed is soon cut off by a fault and does not appear toward the northeast. In the quarry on Marble Creek, where the marble passes into the Murphy quadrangle on the west, the following section is exposed: At the bottom are several feet of white marble with tremolite crystals; above this are 50 feet of pure white marble, 40 feet of blue marble, and 30 feet of white marble. After a small interval in which there are no exposures the ottrelite-bearing Andrews schist outcrops. Thus only a small part of the normal total thickness is exposed.

Joints.—The marble when pure is very resistant to weathering agencies. In course of time its upper parts have been dissolved away, but the remaining rock is perfectly fresh and hard. This general condition is affected somewhat by the lines of micaceous minerals near the top and bottom of the formation, down which weathering has penetrated to considerable depths. It is also seriously affected by joint planes and other planes along which slight movements have taken place. These are particularly conspicuous in some of the sections along Nantahala River, and the action of weather has broken up the marbles and adjoining quartzites into blocks of varying size. These were not caused during the formation of the fault, but seem to be due

to later disturbances along the same lines of weakness. Somewhat similar phenomena are seen where the marble belt contracts again toward the southwest. In that situation too there is a fault plane within a short distance toward the southeast. The exposures of the marble are very poor in that area, but the quartzites are considerably jointed, and probably the marbles are affected in the same way. These joints do not appear when the fresh rock is taken out of the quarries, but are developed by exposure to weather. No noticeable amount of motion has taken place along these planes and they represent merely a tendency to separate. Of slightly different character are various seams along which motion has taken place. These are usually accompanied by a slight development of the silicates in thin films which are frequently striated in the direction of the motion. In places these seams disconnect the portions of the marble, even in the solid rock, and cause it to break up after short exposure. They are not present in all the marble, by any means, and the amount of good material seems to be very large. Where the rock has been extensively quarried in regions farther southwest the character of the stone is not greatly different and the geologic surroundings are substantially the same. It is therefore probable that good material will be abundant in this region.

Accessibility.—While the marble does not often outcrop in this region, there are numberless quarry sites available. The surface of the marble is covered by 6 or 8 feet of soil and gravel along the flood planes of the different streams, and in other positions by a slightly greater amount of wash from the various formations. This is true not only of the entire Valley River basin, but also of the Peachtree and Brasstown areas. In the latter situation, as well as in the bottom lands for large areas below Andrews, the presence of the marble has been proved in scores of places, although it scarcely outcrops at all. Northeast of Red Marble Gap even this thin covering is much lessened and natural outcrops of the marble are frequent. The Murphy branch of the Southern Railway follows closely along the principal marble belt. In fact, the low ground which the railroad follows is, with the exception of 4 or 5 miles, caused directly by the presence of the marble. Thus delivery of the quarried material to the transportation lines is exceptionally easy. Southwest of Marble the formation has an average dip of 50° to 60° , so that long-continued quarrying would entail deep cutting and hoisting. In the same degree the disposal of water would be a question to be considered. The surface of the marble in those localities is seldom more than 60 feet above Valley River, and much less above the minor creeks. Considerable pumping would therefore be necessary in quarries of any depth. Northeast of Marble the situation is much the same, except that the rock is seldom more than a few feet above drainage level. In all these areas, therefore, drainage and disposal of the waste material are of importance. Between Marble and Valletown the dips vary much, but on the average are small. Consequently openings on the marble could readily be extended over the surface and the stone taken out more easily. Northeast of Red Marble Gap the topography is very rugged and presents great natural advantages so far as drainage and disposal of waste are concerned.

The North Carolina Mining and Talc Company are developing their marble deposit at Hewitts. Some splendid blocks of this marble have been taken out and are on exhibition at the Appalachian Exposition, Knoxville, Tennessee. The main obstacle to the development of these marble deposits is high freight rates.

LIMESTONE.

The production of limestone in North Carolina is used for four purposes: for burning into lime, for road building, for a fertilizer, and for chicken grit.

The Yadkin Lime Company of Winston-Salem has been organized to develop the old lime rock near Siloam, in Yadkin County. They have installed crushers and other machinery for grinding the limestone into agricultural lime. The company also hopes to make lime for building purposes.

The King Lime Fertilizer Company of Brevard, Transylvania County, has been organized to develop a quarry. The properties to be developed are what is known as the Old Gash Lime Kilns and the Sims Kilns and other lime properties in that section. The proposed developing includes about three miles of track connecting the properties with the railroad, of six perpetual coal burning lime kilns, and one or more huge rock crushers. The company will furnish ground lime for fertilizer, and burned lime for fertilizer, building and other purposes.

Mr. C. H. Foy, of Kinston, has located a deposit of shell at his lumber camp in Jones County, at Foy's Crossing. An analysis of this shell by the North Carolina Agricultural Station gave 54 per cent lime; and an analysis by the Virginia Agricultural Station showed 60 per cent lime. There seems to be a quantity of this lime in this section, and is said to contribute a great fertility to crops, especially for alfalfa.

A similar deposit in Craven County, near New Bern, is being worked by the Carolina Coast Lime Company and put on the market as a chicken grit and fertilizer.

PRODUCTION.

The production of marble was obtained from one quarry and can not be given separately. The production of lime and limestone was obtained from six counties, which are given in the order of the importance of their production: Henderson, New Hanover, Craven, Beaufort, Jones, and Transylvania.

There is given in the following table the value of the production of limestone from 1901 to 1910, inclusive.

PRODUCTION OF MARBLE AND OTHER FORMS
OF LIMESTONE, 1901-1910.

Year	Value
1901.....	\$ 8,357
1902.....	23,153
1903.....	25,365
1904.....	19,887
1905.....	29,015
1906.....	72,051
1907.....	46,338
1908.....	53,405
1909.....	106,931
1910.....	77,585

SAND AND GRAVEL.

The only figures given under this head are those which could be obtained of sand and gravel used by molders or by railroads. This does not represent all the sand used for molding, as a good deal is used by foundrymen, obtained nearby their places of business and of which no special record is kept as to the quantity obtained, or its cost.

A great deal of sand is used in the manufacture of mortar for brick and stone work which is not taken into account. Also a great deal of sand is used in the manufacture of plaster of which no account is taken. Another use which is increasing rapidly in North Carolina is as sand and crushed stone in the manufacture of concrete.

There are undoubtedly in Eastern North Carolina certain sands of sufficient purity to be used in the manufacture of glass, but to date no manufacturing establishment has been organized for such an industry.

PRODUCTION.

In the following table there is given the production of sand and gravel in North Carolina from 1905, when these figures were first obtained, to 1910 inclusive.

PRODUCTION OF SAND AND GRAVEL
IN NORTH CAROLINA, 1905-1910.

Year	Value
1905.....	\$ 547
1906.....	9,191
1907.....	2,191
1908.....	2,070
1909.....	13,338
1910.....	12,403

It will be seen from the above table that there has been a pretty steady increase in this industry, and, when the advantages of certain of the North Carolina sands are realized, new industries will undoubtedly come up which will utilize these sands and greatly increase the annual production.

SAND-LIME BRICK.

In the report for 1905 there was given a rather complete description of sand-lime brick and their manufacture. The demand for these artificial bricks is increasing and the uses to which they are put are numerous. It is claimed by the manufacturers that the bricks are suitable for use in superstructures and foundations, and for all underground work, especially for sewers; that they improve with age, have great crushing strength; are low in porosity; are poor conductors of heat, and are unaffected by acids. It is also claimed that they are sanitary,

and that they will not disintegrate under extreme climatic changes. On account of their uniform size, shape, and color, it is said that they can be economically laid and be made to produce a like face on both sides of an 8-inch wall. The bricks can be tinted any shade of color desired. There are good possibilities for the development of this industry in Eastern North Carolina, with its large amount of available sand, and a statement concerning the present status of this industry in Germany, where the process of making sand-lime bricks originated, may be of interest, and the following report by Consul-General Robert P. Skinner, Hamburg, on Sand-Lime Bricks in Germany is quoted from the Advance Chapter from Mineral Resources for 1909 on the "Production of Sand-Lime Brick":

The manufacturer of sand-lime bricks (called "kalksandsteine") in Germany has assumed large proportions in the last few years, and the great improvements effected in processes of manufacture amply justify the adoption of this building material in the United States. From 1897 to 1902 alone 80 plants were established in Germany for the production of these bricks, and there are now said to be 280 in operation. Hamburg firms producing kalksandsteine are satisfied with the business results.

Ordinary sand-lime bricks sell at an average price of 2 marks (\$0.476) less per 1,000 than clay bricks. The cost of production is said to be 9 to 12 marks (\$2.142 to \$2.856) per 1,000, but it is difficult to generalize on this, as no two localities are situated alike as to raw materials. In 1902 the German Reichstag purchased 9,000,000 bricks of this kind, made by the Schwartz process, for army buildings at a saving of \$20,000 over clay bricks.

Original Method of Manufacture.—The elementary facts in the brick business are that clay does not exist everywhere, whereas sand is found almost everywhere and can be used at a lower cost. The processes of manufacturing sand-lime brick are numerous, some being protected by patents. The original method of manufacture was as follows:

Fat lime slaked to a thick milk is mixed with six to twelve times its own quantity of coarse sand and then carefully kneaded either by hand or in a mixing machine. Bricks are then formed in an ordinary clay press, and after twenty-four hours, being then slightly dry, are stacked together and assume sufficient hardness after three to four weeks. The hardening process is accelerated by dipping the slightly dry bricks in a very thin solution of silicate of potash.

Thus a very cheap material can be produced for agricultural buildings where lime and good sand are available. The bricks are frost proof and rather compact, and no extensive machinery is required. Sand-lime bricks produced upon an industrial scale are the pressed product of a complete mixture of lime and sand hardened (molded?) under steam pressure of an average minimum compressive strength of 140 kilos per square centimeter (308.64 pounds per 0.155 square inch). This mortar contains 5 to 8 per cent of lime, and upon being pressed into bricks—which are then exposed to a steam pressure, usually under 72 (7.2) atmospheres during eight to ten hours—the bricks can be used at once.

Increasing Success of this Type.—The foregoing process is based upon the discovery, in 1880, of Doctor Michaelis, that salicylic acid can be decomposed, that is to say, can be caused to form hydrated silicate of lime by chemical combination with lime from hydrate of lime only in a very high temperature and in the presence of steam. This high-pressure process has been developed in Germany since 1898, and it is believed that from eight

hundred million to one thousand million bricks of this kind are being manufactured annually. Bricks of this kind are rivaling clay bricks with increasing success, their adoption being furthered by the facts (1) that an extraordinary small quantity of lime is necessary, since the poorest mortar requires more sand than lime; (2) that sand can be found almost everywhere; (3) that the time required to manufacture is short and the general expenses are low; (4) that the bricks can be manufactured at all seasons of the year.

Fat lime is used ordinarily in the manufacture of these bricks and hydraulic lime very seldom. Dolomitic lime, which slakes slowly, is not available. Any kind of quartz sand which is free from clay and not too coarse can be used.

Variations in Component Elements.—The various processes are distinguished from each other by the method of treating the lime. In some the lime is completely slaked to powder or paste before being mixed with the sand, this being the ordinary hydrate process. Elsewhere the lime is ground to powder (quicklime powder), then mixed with sand, and then slaked. The hardening of the bricks is always done in the same manner—in a hardening boiler. According to the first, or hydrate process, the mixed material remains at first amorphous, and then gradually becomes crystalline; whereas in the quicklime process the mixture assumes a crystalline form immediately, which is said to be why the bricks possess a greater solidity from the beginning. However, it is alleged that the quicklime process requires a larger dose of lime, and that the completed bricks are too dense, thus absorbing less water and allowing the passage of less air.

According to Burchartz, there is no material difference between the several kinds of sand-lime bricks as regards density and water absorption, and all kinds of sand-lime bricks increase in compactness within certain limits.

In the pure hydrate process the lime is slaked to powder in a slaking drum or hardening boiler, after having been ground finely. In the mixed processes it is slaked in drums with part of the sand and then, or perhaps after having been stored in silos, it is mixed, with the rest of the sand. In the quicklime process ground-burnt lime is mixed with the entire quantity of sand, water being added steadily to the mixture, which is then pressed, either after having been stored in silos or without previous storing.

Presses of various kinds are in use which have a daily capacity of about 24,000 bricks, which are perfect in shape. Larries loaded with 900 bricks are moved into cylindrical hardening boilers, which are about 2 meters (6.56 feet) wide and 6.25 meters (20.50 feet) long, in which they remain about nine hours under a steam pressure of 8 atmospheres.

Tests for Strength, Etc.—In 255 tests the compressive strength varied greatly, the average, however, being 153 kilos per square centimeter (337.30 pounds per 0.155 square inch), which is the tenacity required in a brick of good quality.

Deviations from the average are less than in the clay brick, a result of the greater symmetry of the sand-lime brick in shape and structure. The loss of strength through the absorption of water averages 14 per cent, and from the effect of frost 17 per cent. The average absorption of water amounted to 14.9 per cent weight and 26.3 per cent volume, percentages also less in the case of sand-lime bricks than with clay bricks. All bricks tested proved to be frost proof. In fire tests and in practical experience these bricks have shown the same properties as clay bricks in regard to the influence of fire and water used in extinguishing it.

Fireplaces, factory chimneys, ring ovens, etc., have been constructed with sand-lime bricks with good results. The adhesive property of the mortar on the bricks has been tested, by using the same kinds of mortar on sand-lime and clay bricks, the results being generally in favor of the former type of brick. The weight of structures made from this material is but slightly greater than those built of clay, and according to an order issued in 1907, no greater weight may be estimated in statistical calculations than was ascertained in the use of clay bricks.

Because of their regular form and uniform dimensions, these bricks can be laid more easily, and can also more readily be cut. This regularity of form and their trim appearance has led to a frequent use of sand-lime bricks as facing stones, it being also possible to color them.

Patents for Special Types.—German patents 138,935 and 151,945 protect the manufacture of non-conducting bricks which are made of a mixture of sand, lime, and fuller's earth. After the steaming, bricks of this kind can be burned, and before being burned may be soaked with "wasserglas" (silicate of potassium or sodium).

German patent 158,615 protects a process for the elimination of the objection that the color of sand-lime bricks changes in rainy weather. According to this process the bricks are covered with a glaze while under steam pressure, which glaze, upon being burned with the bricks, dissolves and combines with the lime silicate in the brick. Various colored glazes may be applied. There are quite a number of other German patents relating to this industry, or branches thereof, full copies of which can probably be obtained if inquirers care to pay the fees.

PRODUCTION.

The following table gives the production of sand-lime brick in North Carolina from the year 1904 to 1910, inclusive. For the past three years there has been a steady decline in the number produced.

PRODUCTION OF SAND-LIME BRICK IN NORTH CAROLINA, 1904-1910.

Year	Common Brick		Front Brick		Total Value
	Number	Value	Number	Value	
1904	1,800,000	\$ 17,500		\$	\$ 17,500
1905	3,185,000	20,953	660,000	8,150	29,103
1906	3,147,000	22,225	760,000	10,750	32,975
1907	4,035,000	29,455	755,000	9,350	38,805
1908*	1,450,000	10,500	300,000	3,500	14,000
1909*					
1910*					

*Production given in General Mineral Table under "Miscellaneous" p. 10.

CLAY.*

Since the publication of the Report on the Mining Industry for 1907, the total value of the production of clay products has been well up around the million dollar mark, with the largest production made in the year 1909. The bulk of the value of the clay production each year is due to the production of common brick. The number of pressed, fancy, and vitrified brick is yet very small in comparison with what might be produced when the quality of the North Carolina clay is considered and the demand for such brick.

While there has been considerable improvement in the last three years in the method of manufacture of common brick, the result of which has been an increase in the value of common brick per thousand, still much remains to be learned, and it is believed that if a course in ceramics could be given in our colleges that it would open a new field of industry to a great many of our people which would undoubtedly prove very profitable and add to the value of the State by the growth of this industry.

During the summer of 1911 the United States Bureau of Mines had an expert in Western North Carolina making investigations as to the kaolin and feldspar deposits with a view to their utilization in the manufacture of pottery. Abundant supplies of feldspar and quartz can be obtained in Western North Carolina which could be used in such an industry and there would be the additional advantage of being able to grind these by waterpower with which North Carolina is well supplied.

The Geological Survey continues to urge upon the brick producers the necessity for bettering their methods of brick making so that a higher class product can be put out, which will bring a better price.

In the following tables there is given the total production of clay products in North Carolina for the years 1902-1910 inclusive.

VALUE OF CLAY PRODUCTIONS OF NORTH CAROLINA FROM 1902 to 1910.

	1902		1903		1904	
	Quantity	Value	Quantity	Value	Quantity	Value
Common brick.....	131,614,700	\$694,827	136,822,900	\$731,802	149,988,850	\$ 795,494
Pressed brick.....	1,233,000	10,825	765,000	8,230	1,510,000	17,375
Vitrified brick.....	600,000	6,000	500,000	5,000	430,000	3,850
Fire brick.....	1,203	407,500	5,250	163,000	2,700	473
Earthenware.....	1,658		612			
Stoneware.....	13,854	13,700				13,462
Sewer pipe, tile, etc.....	72,618	100,989				110,800
	Tons		Tons		Tons	
Kaolin.....	13,322	108,105	8,605	76,000	9,110	76,670
Fire clay.....		215	231	875	202†	761
Total value.....		903,103		942,458		1,021,550

*See also Bull. 13 of the N. C. Geol. Survey.

VALUE OF CLAY PRODUCTIONS OF NORTH CAROLINA—CONTINUED.

	1905		1906		1907	
	Quantity	Value	Quantity	Value	Quantity	Value
Common brick.....	153,610,000	\$896,289	166,338,000	\$1,041,078	174,750,000	\$1,150,185
Pressed brick.....	875,000	13,925	385,000	4,410	770,000	7,925
Vitrified brick.....	400,000	3,600	400,000	4,000	150,000	1,500
Fire brick.....	681,000	8,333	401,000	7,180	194,000	3,490
Earthenware.....		387		713		2,382
Stoneware.....		12,932		11,037		7,840
Sewer pipe, tile, etc.....		102,445		113,900		142,000
	<i>Tons</i>		<i>Tons</i>		<i>Tons</i>	
Kaolin.....	10,988	85,622	10,803	90,036	11,035	85,505
Fire clay.....	107†	519	207	322	903†	968
Total value.....		1,124,052		1,272,696		1,401,813

	1908		1909		1910	
	Quantity	Value	Quantity	Value	Quantity	Value
Common brick.....	143,892,000	\$900,611	188,313,000	\$1,140,727	167,966,000	\$1,039,319
Pressed brick.....	300,000	2,700	725,000	9,250	550,000	5,800
Vitrified brick.....	50,000	400				
Fire brick.....	700,000	7,560				
Earthenware.....		775		1,780		1,961
Stoneware.....		12,587		16,929		13,029
Sewer pipe, tile, etc.....		19,335		133,925		163,555
	<i>Tons</i>		<i>Tons</i>		<i>Tons</i>	
Kaolin.....	10,532	85,300	12,097	99,174	14,080	119,040
Fire clay.....	2,298	349				
Total value.....		1,029,617		1,401,785		1,342,704

†Including ordinary stoneware clay sold crude.

A review of these tables will show that there has been a steady increase in the value of the clay production up to 1907. There was a slight falling off during 1908, which was made up again in 1909, and a slight decrease in 1910.

These tables probably do not represent the total output of all the clay production of the State for the reason that in some counties there are a few thousand brick made for local purposes regarding which it is extremely difficult, or impossible, to obtain statistics, this being especially true where the brick are not for sale but are used directly by those manufacturing them.

KAOLIN.

The North Carolina kaolin is obtained from Jackson, Mitchell and Swain counties. There has been a steady increase in the value of the production of kaolin until it has passed the \$100,000 mark. Owing to the fact that there has been but one company producing for a number of years, the figures are not given here but are included in the general table of clay production.

POTTERY CLAY.

There has been a steady increase in the production of pottery since the year 1907, which reached its maximum in the year 1909 and fell off again in the year 1910.

There is given in the tables below the value of the pottery production for North Carolina, by counties, from the year 1905-1910, inclusive.

VALUE OF THE POTTERY PRODUCTS OF NORTH CAROLINA BY COUNTIES
FROM 1905 TO 1910, INCLUSIVE

County	1905			1906			1907		
	Earthen-ware	Stone-ware	Total	Earthen-ware	Stone-ware	Total	Earthen-ware	Stone-ware	Total
Buncombe.....	\$ 125	\$2,725	\$2,850	\$ 100	\$1,325	\$1,425	\$ 150	\$2,184	\$ 2,334
Catawba.....		1,930	1,930	135	4,800	4,735		1,800	3,192
Chatham.....		500	500						
Johnston.....	100	150	250	50	40	90	100		100
Lincoln.....	20	2,059	2,079		1,757	1,757	100	1,100	1,200
Moore.....		100	100	50	100	150			
Randolph.....		790	790	150	1,495	1,645	435	1,498	1,931
Union.....	109	2,400	2,500	178	918	740	165	750	915
Wilkes.....	42	2,278	2,320	30	1,000	1,030	40	510	550
Total.....	387	12,932	13,319	713	11,057	11,770	2,382	7,840	10,222

County	1908			1909			1910		
	Earthen-ware	Stone-ware	Total	Earthen-ware	Stone-ware	Total	Earthen-ware	Stone-ware	Total
Buncombe.....	\$ 75	\$1,870	\$1,945	\$ 270	\$3,260	\$3,530	\$ 630	\$ 400	\$ 1,030
Catawba.....	145	4,460	4,605	1,030	6,980	8,060	821	7,184	8,005
Johnston.....	100	50	150	a					
Lincoln.....		2,142	2,142	355	4,639	4,994	25	1,560	1,585
Montgomery.....		925	925						
Moore.....	60	300	360	b			300	400	700
Randolph.....	255	1,590	1,845	c			120	1,760	1,880
Union.....	140	1,250	1,390	d				300	300
Wilkes.....				75	2,030	2,125	65	1,425	1,490
Total.....	775	12,587	13,362	1,780	16,929	18,709	1,961	13,029	14,990

a Included with Buncombe; b Included with Wilkes; c Included with Lincoln; d Included with Wilkes.

The next table shows the total value of the pottery produced in North Carolina from 1900-1910, inclusive.

PRODUCTION OF POTTERY IN NORTH CAROLINA,
1900-1910.

Year	Value of Pottery
1900.....	\$ 18,883
1901.....	22,495
1902.....	14,512
1903.....	14,312
1904.....	13,900
1905.....	13,319
1906.....	11,770
1907.....	10,222
1908.....	13,362
1909.....	18,709
1910.....	14,990

FIRE CLAY AND PIPE CLAY.

Under this head are included fire and pipe clays and the products manufactured from them, as fire brick, sewer pipe, drain tile, fancy tile, flue linings, terra cotta, etc.

There is given in the following tables the production of fire clay and pipe clay products from 1901-1910 inclusive which shows a pretty steady increase in the production of these forms of clay product.

PRODUCTION OF FIRE-CLAY AND PIPE-CLAY PRODUCTS IN NORTH CAROLINA, 1901-1910

Year	Fire Brick		Sewer Pipe, Tile, Etc.	Crude Clay	
	Quantity	Value		Tons	Value
1901.....	55,000	\$ 550	\$ 55,745		\$ 100
1902.....		1,203	72,618		215
1903.....	407,503	5,250	100,989	231	875
1904.....	163,000	2,700	110,800	80	700
1905.....	681,000	8,333	102,445	57	494
1906.....	401,000	7,180	113,900	19	185
1907.....	194,600	3,490	142,000	903	986
1908.....	730,000	7,560	19,335	2,298	349
1909.....			133,925		763
1910.....			163,555	80	40

BRICK CLAY.

The enormous progress made by the State of North Carolina during the past several years has of course been accompanied by a great deal of building, which has caused an ever increasing demand for building materials. The production of common brick in the State has therefore increased from year to year quite steadily, but would undoubtedly have increased more if the quality of the brick manufactured had been better. In the early part of the year 1911 the Corporation Commission ordered a reduction in the freight rates on brick, which will undoubtedly encourage this industry.

The table below shows the quantity and value of common, pressed, vitrified and fire brick produced in North Carolina since 1907.

PRODUCTION OF COMMON, PRESSED, VITRIFIED, AND FIRE BRICK IN 1907, 1908, 1909 AND 1910.

Character of Brick	1907		1908		1909		1910	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Common ..	174,750,000	\$1,150,185	143,892,000	\$900,611	188,313,000	\$1,140,727	167,969,070	\$1,039,319
Pressed ..	770,000	7,925	300,000	2,700			550,000	5,800
Vitrified.....	150,000	1,500	50,000	400	725,000	9,250		
Fire.....	194,000	3,490	700,000	7,560				
Totals	175,864,000	\$1,163,100	144,942,000	\$911,271	189,038,000	\$1,149,977	168,518,000	\$1,045,119

There is given in the following tables the number and value of the common brick manufactured in North Carolina, by counties, for the years 1908, 1909, and 1910.

NUMBER AND VALUE OF COMMON BRICK MADE IN NORTH CAROLINA
DURING 1908, BY COUNTIES.

County	Common Brick	Value
Alamance.....	4,820,000	\$ 30,328
Anson.....	1,000,000	7,000
Beaufort.....	1,540,000	9,200
Bertie.....	836,000	6,893
Bladen.....	50,000	400
Buncombe.....	4,396,000	26,019
Burke.....	1,487,000	8,435
Cabarrus.....	5,100,000	35,800
Caldwell.....	900,000	5,400
Camden.....	44,000	375
Catawba.....	2,376,000	11,850
Chatham.....	200,000	1,200
Chowan.....	1,000,000	6,500
Cleveland.....	700,000	4,200
Columbus.....	250,000	2,000
Craven.....	6,791,000	43,241
Cumberland.....	2,500,000	15,039
Davidson.....	300,000	1,650
Duplin.....	80,000	640
Durham.....	3,310,000	21,180
Edgecombe.....	4,014,000	24,781
Forsyth.....	8,500,000	47,200
Gaston.....	4,633,000	27,365
Granville.....	3,350,000	23,150
Greene.....	100,000	800
Guilford.....	6,013,000	33,592
Halifax.....	4,660,000	28,100
Harnett.....	500,000	3,000
Henderson.....	5,250,000	31,125
Iredell.....	2,817,000	18,050
Johnston.....	3,150,000	21,775
Lee.....	500,000	3,000
Lenoir.....	2,050,000	14,650
Lincoln.....	750,000	4,501
McDowell.....	550,000	3,300
Macon.....	130,000	650
Martin.....	1,425,000	8,670
Mecklenburg.....	3,000,000	20,500
Montgomery.....	1,000,000	7,000
Moore.....	650,000	4,350
New Hanover.....	3,200,000	22,560
Orange.....	1,000,000	7,000
Pasquotank.....	1,950,000	12,075
Ponder.....	3,500,000	21,000
Perquimans.....	400,000	2,500
Pitt.....	4,011,000	28,165
Randolph.....	1,350,000	8,387
Richmond.....	450,000	2,700
Robeson.....	1,993,000	14,540
Rockingham.....	450,000	2,850
Rowan.....	2,100,000	16,500
Rutherford.....	500,000	3,400
Sampson.....	350,000	2,350
Scotland.....	150,000	1,200
Stanly.....	300,000	2,100
Stokes.....	1,000,000	6,180
Surry.....	2,950,000	15,125
Union.....	6,795,000	40,630
Wake.....	7,440,000	46,649
Wayne.....	6,750,000	40,500
Wilkes.....	1,050,000	5,300
Wilson.....	5,014,000	34,032
Yadkin.....	238,000	1,100
Unknown.....	125,000	750
Totals.....	143,892,000	\$ 900,611

NUMBER AND VALUE OF COMMON BRICK MADE IN NORTH CAROLINA
DURING 1909, BY COUNTIES.

County	Common Brick No. of Brick	Value
Alamance.....	5,150,000	\$ 33,900
Anson.....	4,421,000	30,283
Beaufort a.....		
Bertie a.....		
Buncombe.....	5,394,000	35,011
Burke.....	3,154,000	16,031
Cabarrus.....	5,025,000	30,150
Caldwell b.....		
Camden b.....		
Catawba.....	2,600,000	13,475
Chatham c.....		
Chowan c.....		
Cleveland.....	2,036,000	11,298
Columbus.....	2,700,000	19,150
Craven.....	6,855,000	37,315
Cumberland.....	4,010,000	26,145
Davidson.....	325,000	2,250
Davie d.....		
Duplin d.....		
Durham.....	6,349,000	40,944
Edgecombe.....	3,843,000	25,362
Forsyth.....	9,437,000	54,648
Gaston.....	2,400,000	13,650
Granville.....	2,850,000	18,475
Guilford.....	10,610,000	60,293
Halifax.....	6,799,000	43,364
Haywood e.....		
Henderson.....	11,200,000	63,610
Iredell.....	3,785,000	26,230
Johnston.....	5,311,000	32,700
Lee e.....		
Lenoir.....	1,563,000	9,244
Lincoln.....	1,150,000	7,725
McDowell f.....		
Martin.....	1,543,000	7,936
Mecklenburg.....	5,885,000	36,561
Montgomery g.....		
Moore g.....		
Nash.....	4,625,000	27,750
New Hanover.....	7,413,000	48,222
Orange h.....		
Pasquotank h.....		
Pender.....	3,350,000	17,700
Perquimans i.....		
Pitt.....	4,425,000	28,512
Randolph.....	2,044,000	12,726
Robeson.....	1,400,000	9,200
Rockingham.....	1,725,000	10,900
Rowan.....	2,550,000	23,800
Rutherford j.....		
Sampson.....	700,000	4,550
Stanly k.....		
Stokes.....	9,941,000	59,676
Surry.....	2,350,000	11,900
Union.....	8,390,000	51,638
Wake.....	10,300,000	58,250
Watauga l.....		
Wayne.....	7,650,000	44,030
Wilkes l.....		
Wilson.....	7,780,000	45,303
Totals.....	188,313,000	\$ 1,140,727

a Included with Anson County production; b Included with Cabarrus County production; c Included with Columbus County production; d Included with Davidson County production; e Included with Lenoir County production; f Included with Martin County production; g Included with Nash County production; h Included with New Hanover County production; i Included with Rockingham County production; j Included with Rowan County production; k Included with Stokes County production; l Included with Wilson County production; m Included with Henderson County production.

NUMBER AND VALUE OF COMMON BRICK MADE IN NORTH CAROLINA
DURING 1910, BY COUNTIES.

County	Common Brick No. of Brick	Value
Alamance.....	5,410,000	\$ 35,520
Anson.....	3,700,000	22,790
Beaufort <i>a</i>		
Bertie <i>a</i>		
Bladen <i>b</i>		
Buncombe <i>b</i>	4,079,000	24,270
Burke.....	2,700,000	13,700
Cabarrus <i>c</i>	4,035,000	27,865
Caldwell <i>c</i>		
Camden <i>c</i>		
Catawba.....	2,950,000	16,275
Chatham <i>d</i>	2,700,000	18,900
Chowan <i>d</i>		
Cleveland <i>e</i>	2,250,000	15,100
Columbus <i>e</i>		
Craven.....	6,210,000	32,273
Cumberland.....	4,520,000	29,621
Davie <i>f</i>	217,000	1,336
Duplin <i>f</i>		
Durham.....	5,012,000	39,072
Edgemcombe.....	2,655,000	17,073
Forsyth.....	7,292,000	45,585
Gaston.....	2,344,000	13,402
Granville <i>g</i>	1,850,000	10,700
Greene <i>g</i>		
Guilford.....	6,458,000	36,148
Halifax.....	5,306,000	33,750
Harnett <i>h</i>	900,000	5,200
Haywood <i>h</i>		
Henderson.....	6,750,000	37,563
Hertford <i>h</i>		
Iredell.....	1,783,000	12,111
Jackson <i>i</i>		
Johnston.....	3,255,000	20,758
Lee <i>i</i>		
Lenoir <i>i</i>	1,578,000	7,536
Lincoln <i>j</i>	2,400,000	14,200
McDowell <i>j</i>		
Madison <i>k</i>	1,047,000	6,127
Martin <i>k</i>		
Mecklenburg.....	9,289,000	55,624
Montgomery <i>l</i>	1,675,000	10,237
Moore <i>l</i>		
Nash <i>m</i>	5,750,000	43,000
New Hanover <i>m</i>		
Pasquotank <i>n</i>	1,660,000	9,050
Pender.....	2,965,000	16,850
Perquimans <i>n</i>		
Pitt.....	4,010,000	26,070
Randolph.....	2,300,000	13,950
Robeson.....	2,350,000	16,050
Rockingham <i>o</i>		
Rowan <i>o</i>	4,225,000	26,200
Rutherford <i>p</i>	419,000	2,475
Sampson <i>p</i>		
Scotland <i>q</i>		
Stanly <i>q</i>	1,875,000	12,600
Stokes <i>r</i>	10,873,000	67,328
Surry <i>r</i>		
Union.....	6,400,000	41,600
Wake.....	10,400,000	60,750
Watauga <i>s</i>		
Wayne <i>s</i>	9,770,000	59,890
Wilkes <i>t</i>		
Wilson <i>t</i>	6,150,000	37,850
Yadkin <i>u</i>		
Yancey <i>u</i>	420,000	2,920
Totals.....	167,966,000	\$ 1,039,319

a Included with Anson County production; *b* Included with Buncombe County production; *c* Included with Cabarrus County production; *d* Included with Chowan County production; *e* Included with Cleveland County production; *f* Included with Duplin County production; *g* Included with Granville County production; *h* Included with Harnett County production; *i* Included with Lenoir County production; *j* Included with Lincoln County production; *k* Included with Madison County production; *l* Included with Montgomery County production; *m* Included with Nash County production; *n* Included with Pasquotank County production; *o* Included with Rowan County production; *p* Included with Rutherford County production; *q* Included with Stanly County production; *r* Included with Stokes County production; *s* Included with Wayne County production; *t* Included with Wilson County production; *u* Included with Yancey County production.

SUMMARY.

In order to show more clearly the value of the mineral production of the State by counties, there is given in the tables below the value of the productions in each county for the years 1907, 1908, 1909, and 1910.

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1907 AND 1908.

County	1907			1908		
	Mineral Production Including Kaolin	Clay Products Except Kaolin	Totals	Mineral Production Including Kaolin	Clay Products Except Kaolin	Totals
Alamance	\$ 38,325		\$ 38,325	\$ 30,328		\$ 30,328
Alexander	4,921		4,921	349		349
Alleghany	800		800	300		300
Anson	3,250	3,500	6,750		7,000	7,000
Ashe	2,750		2,750	1,200		1,200
Beaufort		14,250	14,250		9,270	9,270
Bertie		8,450	8,450		6,893	6,893
Bladen		600	600		400	400
Brunswick						
Buncombe	60,944	21,488	82,432	41,446	28,579	70,025
Burke	7,636	7,000	14,636	3,994	8,435	12,429
Cabarrus	1,522	37,560	39,082	12,275	35,800	48,075
Caldwell		14,275	14,275		5,400	5,400
Camden					375	375
Carteret						
Caswell						
Catawba	6,455	22,617	29,072	2,570	16,873	19,243
Chatham	1,886	8,500	10,386	2,230	1,200	3,430
Cherokee	1,664		1,664	8,175		8,175
Chowan		10,000	10,000		6,500	6,500
Clay						
Cleveland	33,122	6,980	40,102	20,264	4,200	24,464
Columbus		16,000	16,000		2,175	2,175
Craven		17,174	17,174	11,000	43,241	54,241
Cumberland		24,365	24,365		15,038	15,038
Currituck						
Dare						
Davidson	6,304	6,050	12,354		2,785	2,785
Davie		2,700	2,700			
Duplin		2,364	2,364		640	640
Durham		44,957	44,957		21,180	21,180
Edgecombe		21,650	21,650		24,781	24,781
Forsyth		92,014	92,014		48,815	48,815
Franklin	1,188	10,500	11,688	103		103
Gaston	4,650	22,324	26,974	1,419	27,365	28,784
Gates		100	100			
Graham						
Granville	48,973	16,050	65,023	11,092	23,150	34,242
Greene		4,000	4,000		800	800
Guilford	7,441	183,545	190,986	144	51,792	51,936
Halifax		44,800	44,800		28,100	28,100
Harnett		2,800	2,800		3,000	3,000
Haywood	17,400		17,400	15,075		15,075
Henderson	11,463	44,300	55,763	4,500	32,425	36,925
Hertford						
Hyde						
Iredell	3,028	28,200	31,228	1,724	18,050	19,774
Jackson	90,940		90,940	60,600		60,600
Johnston		19,550	19,550		21,925	21,925
Jones						
Lee					3,000	3,000
Lenoir		55,875	55,875		14,650	14,650
Lincoln	6,500	15,265	21,765	1,500	6,649	8,149
McDowell	12,480	1,100	13,580	849	3,300	4,149
Macon	36,625	1,000	37,625	27,200	6,650	33,850
Madison	30,855		30,855	11,180		11,180
Martin		670	670		8,670	8,670
Mecklenburg	13,872	45,200	59,072	13,071	20,500	33,571
Mitchell	190,569		190,569	128,647		128,647

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN
1907 AND 1903.—CONTINUED.

County	1907			1903		
	Mineral Pro- duction Including Kaolin	Clay Products Except Kaolin	Totals	Mineral Pro- duction Including Kaolin	Clay Products Except Kaolin	Totals
Montgomery.....	\$ 52,848	\$ 5,000	\$ 57,848	\$ 60,028	\$ 7,925	\$ 67,953
Moore.....	11,519	8,150	19,669	18,250	4,710	22,960
Nash.....	5,600	28,000	33,600	20,100	—	20,100
New Hanover.....	35,973	18,750	54,723	12,480	22,500	34,980
Northampton.....	—	—	—	—	—	—
Onslow.....	—	—	—	—	—	—
Orange.....	10,098	3,913	14,011	295	7,000	7,295
Pamlico.....	—	—	—	—	—	—
Pasquotank.....	—	14,275	14,275	—	12,475	12,475
Pender.....	—	7,250	7,250	—	—	21,000
Perquimans.....	—	1,400	1,400	—	—	2,500
Person.....	30,973	2,400	33,373	5,835	—	5,835
Pitt.....	—	15,000	15,000	—	28,165	28,165
Polk.....	22,670	—	22,670	4,165	—	4,165
Randolph.....	300	20,701	21,001	87	10,242	10,329
Richmond.....	—	—	—	68,841	2,700	71,541
Robeson.....	—	8,350	8,350	—	14,540	14,540
Rockingham.....	58,960	5,075	64,025	27,300	2,850	30,150
Rowan.....	475,289	47,300	522,589	323,634	16,500	340,134
Rutherford.....	17,659	7,956	25,615	18,409	3,400	21,809
Sampson.....	—	—	—	—	2,350	2,350
Scotland.....	17,250	500	17,750	10,000	1,200	11,200
Stanly.....	50	1,400	1,450	1,038	2,100	3,138
Stokes.....	3,865	1,019	4,914	2,770	6,180	8,950
Surry.....	286,154	19,000	305,154	176,031	15,125	191,206
Swain.....	92,549	—	92,549	67,143	—	67,143
Transylvania.....	4,310	—	4,310	3,490	—	3,490
Tyrrell.....	—	—	—	—	—	—
Union.....	521	38,113	38,634	2,151	42,070	44,221
Vance.....	8,400	—	8,400	5,775	—	5,775
Wake.....	5,478	41,515	46,993	12,475	46,689	59,164
Warren.....	46,478	—	46,478	90,380	—	90,380
Washington.....	—	—	—	—	—	—
Watauga.....	30	—	30	—	—	—
Wayne.....	1,045	51,500	52,545	1,025	40,500	41,525
Wilkes.....	118	7,350	7,468	188	5,300	5,488
Wilson.....	—	44,850	44,850	19,892	34,032	53,924
Yadkin.....	—	560	560	—	1,100	1,100
Yancey.....	60,035	—	60,035	30,000	—	30,000
Unknown.....	2,014	—	2,014	35	750	785
Totals.....	\$ 1,857,414	\$ 1,316,308	\$ 3,173,732	\$ 1,326,799	\$ 944,317	\$ 2,307,116

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA
IN 1909 AND 1910.

County	1909	1910
	Total Value of Mineral Production	Total Value of Mineral Production
Alamance.....	\$ 33,900	\$ 35,520
Alexander.....	1,398	750
Alleghany.....	400	500
Anson.....	5,850	13,103
Ashe.....	155	500
Avery.....		
Beaufort.....	26,923	21,790
Bertie a.....		a
Bladen.....		a
Brunswick.....		
Buncombe.....	82,844	64,505
Burke.....	23,285	16,263
Cabarrus.....	21,796	21,229
Caldwell.....	17,800	6,865
Camden b.....		b
Carteret.....		
Caswell.....		
Catawba.....	35,695	25,146
Chatham.....	2,000	13,490
Cherokee.....	31,283	22,325
Chowan b.....		b
Clay.....		
Cleveland.....	39,273	18,059
Columbus.....	10,091	3,550
Craven.....	52,371	48,916
Cumberland.....	26,145	29,621
Currituck.....		
Dare.....		
Davidson.....	2,353	145
Davie.....	2,560	8,200
Duplin c.....		c
Durham.....	41,794	40,558
Edgecombe.....	25,362	17,073
Forsyth.....	54,648	45,659
Franklin.....	39	1,011
Gaston.....	14,583	16,034
Gates.....		
Graham.....		
Granville.....	48,342	19,170
Greene.....		1,500
Guilford.....	190,415	197,404
Halifax.....	47,094	35,550
Harnett.....	2,678	1,600
Haywood.....	1,550	7,075
Henderson.....	99,480	60,882
Hertford.....		3,000
Hoke.....		
Hyde.....		
Iredell.....	27,736	12,949
Jackson.....	51,599	53,801
Johnston.....	33,032	21,458
Jones.....	12	1,030
Lee.....	7,694	5,200
Lenoir.....		d
Lincoln.....	12,032	3,807
McDowell.....	2,850	14,594
Macon.....	45,732	50,300
Madison.....	21,785	20,824
Martin.....	5,436	5,347
Mecklenburg.....	63,701	80,678
Mitchell.....	191,777	250,127
Montgomery.....	8,692	62,305
Moore.....	16,200	27,470
Nash.....	18,031	13,500
New Hanover.....	59,138	48,250
Northampton.....		
Onslow.....		
Orange.....	27,972	

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA
IN 1909 AND 1910.—CONTINUED.

County	1909	1910
	Total Value of Mineral Production	Total Value of Mineral Production
Pamlico.....	\$.....	\$.....
Pasquotank.....	^e	25,900
Pender.....	18,200	ⁱ
Perquimans.....	^e	
Person.....		17,480
Pitt.....	28,512	26,070
Polk.....	5,930	19,048
Randolph.....	16,403	21,708
Richmond.....		
Robeson.....	9,234	16,227
Rockingham.....	310,784	47,760
Rowan.....	178,984	397,930
Rutherford.....	20,857	3,125
Sampson.....	4,723	1,000
Scotland.....		8,100
Stanly.....	12,263	13,032
Stokes.....	49,552	53,504
Surry.....	186,394	278,723
Swain.....	99,564	80,963
Transylvania.....	7,337	6,770
Tyrrell.....		
Union.....	52,003	45,300
Vance.....	75,396	17,220
Wake.....	63,308	69,155
Warren.....	^f	54,344
Washington.....		
Watauga.....	^g	^j
Wayne.....	46,338	59,810
Wilkes.....	6,685	6,536
Wilson.....	40,716	34,380
Yadkin.....	812	420
Yancey.....	32,660	59,284
Unknown.....	945	
Totals.....	\$2,783,826	\$ 2,848,446

^a Included with Beaufort County; ^b Included with Caldwell County; ^c Included with Durham County; ^d Included with Lee County; ^e Included with Orange County; ^f Included with Vance County; ^g Included with Wayne County; ^h Included with Cherokee County; ⁱ Included with Pasquotank County; ^j Included with Warren County.

PUBLICATIONS
OF THE
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Out of print.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 50 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Out of print.*
11. Corundum and the Basic Magnesians Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 50 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 6 cents.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade Trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglas B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. Water-powers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*
21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
22. A Report on the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp., 22 pl., 5 figs. *Postage 15 cents.*
23. Forest Conditions in Western North Carolina, by J. S. Holmes, 1911. 8°, 115 pp., 8 pl. *Postage 15 cents.*

ECONOMIC PAPERS.

1. The Maple-sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

† Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monasite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrences, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monasite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestones; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos, and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monasite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines, in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monasite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monasite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monasite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monasite in Original Matrix.

15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monasite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

19. Forest Fires in North Carolina During 1909, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pl. *Postage 5 cents.*

20. Wood-using Industries of North Carolina, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Postage 7 cents.*

21. Proceedings of the Third Annual Drainage Convention, held under Auspices of the North Carolina Drainage Association; and the North Carolina Drainage Law (codified). Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp., 3 pl. *Postage 5 cents.*

22. Forest Fires in North Carolina During 1910, by J. S. Holmes, Forester, 1911. 8°, 48 pp. *Postage 3 cents.*

23. Mining Industry in North Carolina During 1908, '09, and '10, by Joseph Hyde Pratt and Miss H. M. Berry, 1911. 8°, 134 pp., 1 pl., 27 figs. *Postage 10 cents.*

Gives report on Virginiana Copper District of North Carolina and Virginia, by F. B. Laney; Detailed report on Mica Deposits of North Carolina, by Douglas B. Sterrett; Detailed report on Monasite, by Douglas B. Sterrett; Reports on various Gem Minerals, by Douglas B. Sterrett; Information and Analyses concerning certain Mineral Springs; Extract from Chance Report of the Dan River and Deep River Coal Fields; Some notes on the Peat Industry, by Professor Charles A. Davis; Extract from report of Arthur Keith on the Nantahala Marble; Description of the manufacture of Sand-lime Brick.

24. Fishing Industry of North Carolina, by Joseph Hyde Pratt, 1911. 8°, 44 pp. *Postage 5 cents.*

VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. The Coastal Plain Deposits of North Carolina, by Wm. Bullock Clark, Benjamin L. Miller, L. W. Stephenson, B. L. Johnson and Horatio N. Parker.

Pt. I.—The Physiography and Geology of the Coastal Plain of North Carolina, by Wm. Bullock Clark, Benjamin L. Miller and L. W. Stephenson.

Pt. II.—The Water Resources of the Coastal Plain of North Carolina, by L. W. Stephenson and B. L. Johnson. *In Press.*

BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble, Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp.
Postage 1 cent.

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp.
Postage 1 cent.

Administrative report.

Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp.
Postage 2 cents.

Administrative report.

Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp.
Postage 2 cents.

Administrative report.

Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp.
Postage 1 cent.

Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp.
Postage 2 cents.

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Gives special report on an Examination of the Sand-banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders, of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report. Contains Agreements for Coöperation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract, Buncombe County; Transylvania County State Farm; certain Waterbeds; Reforestation of Cut-over and Abandoned Farm Lands; on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county-seats in North Carolina; list of Magnetic Declination at the county-seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a letter should accompany sample and stamp should be enclosed for reply.

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of postage needed, as indicated above, for mailing the bulletins desired, to the State Geologist, Chapel Hill, N. C.

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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

ECONOMIC PAPER No. 24

FISHING INDUSTRY OF NORTH CAROLINA

BY

JOSEPH HYDE PRATT, Ph.D.



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1911

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LETTER OF TRANSMITTAL.

CHAPEL HILL, N. C., December 1, 1911.

To His Excellency, HONORABLE W. W. KITCHIN,

Governor of North Carolina.

SIR:—A Fish Convention has been called by the North Carolina Geological and Economic Survey, the North Carolina Fish Commission, and the North Carolina Oyster Commission, in order to discuss the report made by the special committee appointed by the Legislature of 1909, with a view to checking the great decrease in the fishing industry of eastern North Carolina. I submit herewith for publication Economic Paper No. 24, which gives the report of this committee, together with certain information with regard to the fishing industries and the work of the committee; and it is believed that this report will further the work of this convention.

Yours respectfully,

JOSEPH HYDE PRATT,
State Geologist.

FISHING INDUSTRY OF NORTH CAROLINA.

By JOSEPH HYDE PRATT, Ph.D.

The three natural industries from which a State derives its wealth are: (1) Agriculture and Forestry; (2) Mining; and (3) Fishing. Upon these three industries all the others are dependent for their raw material. Splendid progress and advancement have been made in agriculture and forestry, and in mining, and measures have been advanced and legislation passed to protect and conserve the natural resources connected with these two industries. In some States this is also true of the fishing industry. In North Carolina, however, our General Assemblies have not looked upon this industry as of any particular value to the State, but have considered it as simply a local or county question. Instead of its being a local question, the fishing problem is a State-wide matter; because, in the first place, the navigable waters in the State are absolutely under the control of the Federal and State governments and the fish that live in these waters belong to the State as a whole, and not to the county or community in which the waters happen to be located; in the second place, every person in North Carolina has a perfect and constitutional right to fish in any of the navigable waters belonging to the State, and because of such right is interested from a personal standpoint in the protection and conservation of the fishes inhabiting these waters; and, in the third place, the protection of the fish and the fostering of the fishing interests cannot be carried on by the county, but must be undertaken by the State, if the measures advocated are to be successfully carried out. Thus in passing laws to protect and foster our fishing industries, we must consider the State before the county, and the whole people before the individual.

This lack of consideration of this important problem as a State measure was never more strikingly illustrated than during the past session (1911) of the General Assembly of North Carolina. At this session a State-wide fish bill, which had been prepared as a result of a very thorough and systematic investigation by a special committee appointed by the General Assembly of 1909 and which had been considered and thoroughly discussed in joint meetings of the fish committees of the House and Senate, and was the bill finally agreed upon, was passed by the House, but defeated in the Senate on account of *senatorial courtesy*. Because certain Senators did not want the act to apply to their counties,

these counties were excepted, thus destroying the value and purport of the bill, the Senate not realizing that this was a State-wide measure, and must be considered as such to be effective.

PRODUCTION OF FISH.

If one will take the time to investigate the fishing conditions in North Carolina and the value of the output of this industry, he will be surprised at its constant decrease in value from year to year. Instead of the fishing industry being worth from *seven* to *eight* million dollars to eastern North Carolina, it is now worth less than *two* million. The latest available statistics on the catch of fish in North Carolina is a report of the United States Bureau of the Census for the year 1908, and it also gives some very interesting figures regarding this industry in North Carolina. This report shows that in 1908 there were in North Carolina 9,681 persons employed in the fishing industry; that the capital invested in vessels and boats, including outfit, was \$533,000; in apparatus of capture \$367,000; in shore and accessory property and cost \$370,000. These figures give a little idea of the importance of the industry at the present time.

Since 1902 there has been a decline in the number of persons employed and a corresponding decrease in the value of the vessels, apparatus of capture and other equipment. The vessel fisheries gave employment in 1908 to only a small percentage of the total number of persons reported. The shore and boat fisheries are credited with 8,571 persons, or 89 per cent of the total number, while 1,066, or 11 per cent, were engaged in the vessel fisheries and on the transporting vessels. Only 44 shoresmen were reported. By far the larger number of persons reported for vessel fisheries and transporting vessels were wage-earners. For the shore and boat fisheries of North Carolina a larger proportion of wage-earners and a smaller proportion of independent fishermen were reported than for the same class of fisheries in other States. Many of the persons employed in the industry fished only a part of the year, and during the remainder of the time engaged in farming and other occupations.

The statistics relating to the catch of fish include more than forty species of fish, including oyster, clams, and other mollusca; but do not include frogs, crab, shrimp, otter, whalebone, and whale oil, or the hides and oil of porpoise. All of these latter have been produced in small amount in this State at different times. The United States Bureau of Fisheries, in reply to a letter from the State Geologist, has made a very careful comparative analysis of the statistics of 1902 and 1908, and this letter is here given:

DEPARTMENT OF COMMERCE AND LABOR

BUREAU OF FISHERIES

WASHINGTON

February 18, 1910.

DR. JOSEPH HYDE PRATT, *State Geologist,*
Chapel Hill, N. C.

SIR:—In reply to your inquiry, you are informed that this Bureau cannot furnish you, in the form or detail which you desire, a comparison between the fisheries of North Carolina five years ago and at the present time. The Bureau has made no statistical canvass of the State since 1902, and the recent inquiry conducted by the Bureau of the Census was on a different basis, and such information as it furnishes applies to the State as a whole and is incapable of analysis in respect to the several counties.

The Bureau has prepared from the data available the appended Table I, making a comparison of the catch of the important species of fishes in the years 1902 and 1908, respectively. As the condition of the fisheries in respect to the necessity of regulation is indicated by the quantity caught rather than by the value of the catch, the comparison is based on the former factor, though the value of the product of each species in the year 1908 is shown to exhibit their comparative commercial importance.

TABLE I.—CATCH OF FISH IN NORTH CAROLINA DURING 1908.

SPECIES.	1902.	1908.		Quantity, Decrease Per Cent.
	Quantity, Pounds.	Quantity, Pounds.	Value.	
Alewives (Herring).....	11,172,975	10,927,000	\$ 140,380	2.2
Black bass.....	632,675	511,300	39,610	17.3
Bluefish.....	977,142	1,256,500	45,170	*22.2
Butterfish.....	83,218	1,302,000	28,990	*1,469.0
Croakers.....	2,928,635	1,177,100	31,190	39.0
Flounders.....	261,762	402,900	16,360	*54.0
Hickory shad.....	684,896	377,000	20,230	45.0
Kingfish or whiting.....	120,480	816,600	27,710	*580.0
Menhaden.....	18,862,000	57,412,300	70,330	*204.0
Mullet.....	6,705,492	5,070,500	174,760	21.0
Perch (white and yellow).....	1,047,042	1,353,300	58,270	*29.0
Shad.....	6,566,724	3,942,300	372,920	40.0
Spanish mackerel.....	354,084	457,300	34,210	*29.0
Spot.....	872,695	852,300	15,720	2.0
Squeteague or trout.....	3,781,456	4,634,600	206,240	*23.0
Striped bass.....	1,175,400	509,700	36,250	111.0
Total.....	63,764,984	97,772,300	\$ 1,776,020	

*Increase.

It will be observed that the total catch of fish in 1908 exceeded that of 1902 by over 35,000,000 pounds, or about 65 per cent, though, it may be remarked, the value of the catch was less than 4 per cent greater. The increase in the catch was almost wholly due to the fishery for menhaden, which has annually grown more intense and important for the past ten years, and more than trebled in its product between 1902 and 1908. Considering the food fishes alone, the total catch of the fifteen species enumerated has decreased about 5 per cent in quantity and the value has increased about the same percentage. For practical purposes the two may be regarded as on an equality in the two years cited. An analysis of the details of the table shows wide variation in the catch of the individual species, eight exhibiting a decrease and seven an increase in the year 1908.

The species which show an apparent decrease in abundance are mainly those which were most valuable in 1902. Of those whose value exceeded \$50,000 in that year the catch of five decreased and two increased. Of the less valuable fishes six exhibit an increase and three a decrease in the quantity caught.

It would appear, therefore, that as the more valuable species, such as the shad, became scarcer, the fishermen put forth greater exertion to take the less valuable fishes, and that many which before were more or less discarded were placed on the market. This is a common phenomenon of a fishery becoming depleted.

A further analysis shows that of the fishes exhibiting a decrease in 1908, the majority were either anadromous or resident species, that is, fishes which are more certainly affected by the local fisheries of North Carolina, while those species which were caught in increased abundance were mainly those ranging widely or which do not habitually return to their native waters. Of the anadromous class we have the alewives, hickory shad, shad, and striped bass, which have decreased, while the white perch has increased. The mullet, which may be called semi-anadromous, has decreased.

Of the resident species we have two, one of which, the black bass, has decreased, while the flounder has increased very materially in the catch. The latter is one of the fishes more highly regarded than formerly, its price rising from 2 cents per pound in 1902 to over 4 cents in 1908; and it is probably true in North Carolina, as in other places, that many are now saved by the fishermen and shipped, when formerly they were thrown away as trash fish.

Of the strictly pelagic, or widely wandering, fish, three species are listed. These are the bluefish, the Spanish mackerel, and the squeteague, the catch of all of which was greater in 1908 than in 1902. Of what may be called semi-wandering species there are four, of which the butterfish and the kingfish or whiting have increased, the croakers have decreased, while the quantity of spots taken has remained nearly stationary. These four species move back and forth between the sea and the sounds without much system.

From the foregoing it appears reasonable to deduct the conclusion that those fishes have decreased for which there has been a good demand, and which were therefore the objects of an intense fishery, and which at the same time had habits making them especially susceptible to the influence of the local fishery. The fishes of which a greater quantity are now caught are those for which there was formerly an inferior demand and which have more or less wandering habits, not leading them to return to State waters.

Of the shad which for years has constituted between 30 and 40 per cent of value of the catch of fishes, excluding the oyster and other shellfishes, the Bureau can speak with confidence. In 1897 there were caught 8,963,488 pounds, valued at \$362,811; in 1902, 6,566,724 pounds worth \$384,808, and in 1908, 3,942,300 pounds, yielding the fishermen \$372,920. While the value of the catch has remained practically stationary, the quantity has decreased 40 per cent since 1902 and 127 per cent since 1897. Between 1897 and 1902 there was an increase of 115 per cent in pound nets, 50 per cent in seines, and a decrease of about 50 per cent in the gill nets in use in the State.

Between 1901 and 1905 the supply of ripe eggs which the Bureau was able to obtain for its hatchery at Edenton fell from 75,000,000 to 6,748,000. Since 1905 the yield has gradually risen from the low level stated to 59,685,000 in 1909. The average annual yields for three-year periods since 1901 have been as follows:

1901-1903.....	49,900,000	eggs.
1904-1906.....	10,889,000	eggs.
1907-1909.....	46,398,000	eggs.
1909-.....	59,685,000	eggs.
1910-.....	69,000,000	eggs.

The yield for 1909 was higher than for any year since 1901.

The reason for the decrease in the first two periods and for the increase in the third appears not difficult of determination. The eggs are all obtained at the upper end of Albemarle Sound, and the ripe fish taken there, in their course from the sea to the spawning grounds, must first pass through the narrow confines of the inlets and sounds, where they are especially open to capture. Prior to 1906 there was a great increase in the number of nets of all kinds, and they were fished in such manner that they served as almost complete barriers to the passage of the fish.

In 1905 a law was passed maintaining an open channel, free from nets of all kinds from the inlets to the spawning grounds, and in 1906 its effect became apparent by an increase in the number of eggs taken to 25,643,000 from the insignificant take of 6,748,000 in the previous year, and by 1909 the take had again more than doubled.

The Bureau has no data from which to determine whether the catch of shad in the upper sounds has increased since 1906, but there is little doubt that it has, as stated by the fishermen, and there can be no doubt that a much larger proportion of the fish are propagating both through natural means and the agency of the hatchery.

These facts furnish the clue to the means by which the fisheries of North Carolina may be fostered and perpetuated. The fish must be given access to their spawning grounds, and the hatchery must be granted every facility for obtaining its supply of eggs. The nets must be restricted as to location and if necessary as to number and size so as to furnish an avenue of passage for the fish. Furthermore, the laws must be so drawn that, while restricting reckless fishing, they must not interfere with the capture of fish for the specific purposes of artificial propagation, nor make the cost of obtaining ripe eggs so high as to be prohibitive.

That these ends may be effectively attained it is obligatory that the administration of the laws be vested in State officers and not committed to county

authority with local prejudices and a limited purview. Local regulation of the fisheries has everywhere proved a complete failure, and to experiment with it is to invite disaster to the fisheries committed to its care.

[Signed] GEO. M. BOWERS,
Commissioner.

One noticeable fact that is brought out in this discussion is, that the fish that were the most valuable and important in 1902, such as the shad, black bass, mullet, and striped bass, all showed a very decided decrease in quantity and value in 1908, and those that increased were principally fish which were considered as having no particular value for market in 1902, such as the butterfish. The great increase in the total quantity of fish caught in 1908 as compared with 1902 is due to the catch of menhaden, which are used for the extraction of oil and fertilizer purposes. The increase in value between the 18,862,000 pounds caught in 1902 and the 57,412,000 pounds caught in 1908 was only \$39,000. This particular side (fishing for menhaden) of the fishing industry has constantly increased since 1902.

Special attention should be called to the catch of mullet. While the total weight of the mullet catch of 1908 was over one and one-half million pounds less than 1902, yet the total number of fish of the 1908 catch was very much in excess of that of 1902, and was due to the fact that young mullet are now caught and put on the market which sometimes do not bring a sufficient price to pay the transportation charges on them. If these mullets had been allowed to remain in the water for another year, they would, on account of their rapid growth, have increased to a very marketable fish and would be worth several times per pound more than when marketed as small fish.

North Carolina has for years produced the greatest number of shad of any of the Southern States; but, in 1908, the Virginia catch was considerably in excess of that of North Carolina.

One other point that is emphasized by this statistical report is the absence of any statistics regarding sturgeon, a fish which at one time was caught in considerable numbers in the North Carolina waters, but which now is slowly becoming exterminated. Laws should be passed and enforced for the protection of this fish, as it would be possible in a few years with sufficient protection to bring the sturgeon industry back to a paying basis in this State.

As is seen from the above table, the total value of the fish, exclusive of oysters, clams, and other mollusca, caught in North Carolina during 1908 was \$1,776,000. The value, however, of the oyster and other shellfish did not bring the total value of the fishing industry in North Carolina up to the two-million-dollar mark.

PRODUCTION OF OYSTERS.

The oysters produced in the fishing season of 1907-08, as reported by the Oyster Commissioner, amounted to 210,832 bushels, which, valued at 30 cents per bushel, gives a total value of \$63,249. During the fishing season of 1901-02 the catch reported was 693,516 bushels, which at that time was valued at an average of 25 cents per bushel.

In the following table is given the catch of oysters from the year 1902 to 1908, inclusive:

OYSTERS PRODUCED IN NORTH CAROLINA, 1902-'08.

Season.	Number of Bushels.
1901-02.....	693,516
1902-03.....	658,769
1903-04.....	505,131
1904-05.....	531,854
1905-06.....	351,429
1906-07.....	349,979
1907-08.....	210,832

There are several reasons for this decrease other than the depletion of the natural beds, although the latter is the chief cause. We can sum up the cause of the depletion of the beds, however, to the fact that the laws passed for protecting these oyster beds have not been enforced. The State of Virginia holds first place in the country in the oyster industry; and, when considered amongst the southern States, Virginia is first and Maryland second. As was stated in a recent article by the Oyster Commissioner of Virginia:* "Maryland is far behind Virginia in the laws, methods, and administration of its oyster industry, while North Carolina and other South Atlantic States are hardly in the running." The article also makes the statement that: "In four days time during the present season there were taken from the beds of either the James or Potomac rivers more and better oysters than were cropped in the whole State of North Carolina during the past season." And the 40,000 bushels a day was not an uncommon catch from either rivers at the beginning of the season of 1910. It is estimated that the Virginia catch of oysters for 1910-11 was approximately three and one-half million dollars, while the catch of North Carolina oysters was not over \$50,000. Practically, the Virginia industry is seventy times that of the North Carolina, and yet we have a tremendous area in which the oyster will grow naturally and can be profitably cultivated. Un-

*"Virginia Fishing Industry," Oysterman and Fisherman, April, 1911, p. 9.

doubtedly, the one thing that is reacting against North Carolina is the fact that we are not doing anything to protect and conserve our natural rocks or encourage the cultivation of the oyster.

The following table will give a comprehensive idea of the value of the fish and oyster industries of the South Atlantic States, as far as they could be obtained, and, for comparison, the value of these fishes in New Jersey and Connecticut are given:

STATISTICS OF FISH AND OYSTER INDUSTRIES FOR THE YEAR 1908.

State.	Fish.		Oysters.	
	Value.		Bushels.	Value.
Maryland	\$ 1,078,000		6,230,000	\$ 2,228,000
Virginia	2,368,000		4,075,000	2,348,000
North Carolina	1,776,000		210,832	63,249
Georgia	862,000		1,459,000	339,000
Florida	*3,093,000			296,000
Connecticut	499,000			2,583,000
New Jersey	2,700,000		2,586,000	1,369,000

*This includes the value of the sponges and of the alligators.

Another interesting fact to be drawn from the statistics regarding the oyster is given in the following table, which shows what proportion of the catch of oysters were taken from cultivated grounds and what proportion from the natural rocks in the different States:

CATCH OF OYSTERS FROM PUBLIC AND PRIVATE BEDS IN 1908.

State.	From Public (Natural Rock).		From Private or Cultivated Beds.		Total.	
	Bushels.	Value.	Bushels.	Value.	Bushels.	Value.
Maryland	6,076,000	\$ 2,142,000	154,000	\$ 86,000	623,000	\$ 2,228,000
Virginia					4,075,000	2,348,000
North Carolina	199,832	54,644	11,000	8,605	210,832	63,249
Georgia	507,000	*101,000	952,000	*238,000	1,459,000	339,000
Florida		296,000				296,000
Connecticut†						2,583,000
New Jersey		249,000		1,120,000		1,369,000

*Estimated.

†Principally from private beds.

It will be noticed from the above table that the oyster catch in most of the States was largely from cultivated beds, in some States the production from the cultivated beds being much greater than from the

natural rocks. In North Carolina the production from cultivated beds is extremely small, although the State is abundantly supplied with bottoms well suited to the cultivation of the oyster.*

LEGISLATIVE FISH COMMITTEE OF 1909.

The General Assembly of 1909, after the introduction of numerous fish and oyster bills, finally settled the whole question *for that year* by passing the following resolution:

A JOINT RESOLUTION RELATING TO THE PROMOTION OF THE FISHERY INDUSTRY OF NORTH CAROLINA.

Realizing the great value of the fisheries to the State of North Carolina, that these fisheries are being rapidly depleted, and that some measures are necessary to prevent this depletion, and that steps should be taken to foster and perpetuate these industries: therefore, be it

Resolved by the House of Representatives, the Senate concurring:

SECTION 1. That there shall be created a committee of seven, three to be appointed by the Speaker of the House from the members of the House of Representatives and two by the President of the Senate from the members of the Senate. Of the three members of the House one shall be from the western part of the State, one from the central part of the State, and the third from the eastern part. The President of the Senate shall appoint one member from eastern North Carolina and one from the central part of the State. None of the seven members of the committee shall be financially interested in any of the fisheries. The President of the Senate and Speaker of the House of Representatives shall be members of said committee.

SEC. 2. This committee shall thoroughly investigate the fisheries of North Carolina, including finfish, oyster, clam, and other mollusca, crab, lobster, terrapin, etc., and make a report in the form of a bill, to be presented to the Legislature of 1911, which will embody such legislation as in their judgment they deem best for the building-up of the fisheries of North Carolina.

SEC. 3. In order to facilitate the work of this committee, they are hereby authorized to request the Commissioner of the United States Bureau of Fisheries to detail one of their experts to sit with the committee during its deliberations. The committee is further authorized to visit and examine any portion of the waters of North Carolina which they deem necessary in order to fully inform themselves upon the existing conditions relating to the fishery industries. This committee is also further authorized to use the State boat under the control of the Oyster Commissioner in going from one part of the rivers and sounds of eastern North Carolina to another. The committee is also further authorized to call in for consultation the Fish Commissioner, the Oyster Commissioner, the State Geologist, and other public servants that they believe can give them any information of value regarding the fishery industries. They are further authorized to sit at some central point in eastern North Carolina, after they have visited what places they deem necessary for the collection of information, where delegations of fishermen or representatives

*See Bulletin 15, on the Cultivation of the Oyster in North Carolina.

of fishermen from various portions of eastern North Carolina can appear before the committee to give information regarding the fisheries of the State.

SEC. 4. The committee shall be allowed all their actual expenses attending to this work and four dollars per diem while in the actual performance of their duties, but the per diem shall not be for more than thirty days.

SEC. 5. This act shall be in force from and after its ratification.

Ratified this the 4th day of March, A. D. 1909.

The committee appointed under this act consisted of the following: Lieutenant Governor W. C. Newland, President of the Senate; Judge A. W. Graham, Speaker of the House; Senators E. L. Travis of the Fourth District and John A. Barringer of the Twenty-first District; Representatives R. A. Doughton of Alleghany, Harry Stubbs of Martin, and J. H. Currie of Cumberland. The U. S. Bureau of Fisheries was asked to send an expert to serve on this committee, and Dr. H. F. Moore of that Bureau rendered very able assistance in connection with this investigation. The committee was also assisted by the State Geologist.

OUTLINE OF WORK OF COMMITTEE.

The committee planned out its work as follows:

First, to make a trip into eastern North Carolina at a time when meetings could be held at various points to which the fishermen could come and give information regarding the industry in their section, and also discuss with this committee various fishing problems.

Second, to make another visit in the spring during the height of the fishing season when the fishermen could be visited while at their work.

Third, to hold sufficient committee meetings to enable its members to thoroughly comprehend the information collected, and to draft from this information a bill which the committee would believe would be satisfactory to the fishing public of North Carolina.

This program was very exactly carried out. The first trip was made in July, 1909, the following itinerary being carried out without a single change:

1909 Itinerary of Fish Committee.

Tuesday,	July 6.	Assemble at Edenton. Spend the day going up Chowan River, across the sound to mouth of Roanoke River.
Wednesday,	July 7.	Public meeting at Edenton. Fishermen from Pasquotank, Perquimans, Chowan, Gates, Hertford, Bertie, Washington, and Tyrrell counties attended this meeting.
Friday,	July 9.	Public meeting at Manteo, Dare County. Trip to Nags Head.
Saturday,	July 10.	Sail around Roanoke Island, noting conditions at Oregon Inlet, New Inlet, Marshes, etc.
Sunday,	July 11.	Nags Head.

- Monday, July 12. Meeting at Point Harbor, Currituck County. Fishermen in Camden and Currituck counties attended.
- Tuesday, July 13. Manteo to Stumpy Point, to Long Point and to Hatteras. Meeting at Hatteras at night.
- Wednesday, July 14. Informal meeting at Hatteras in a. m. These meetings accommodated the fishermen all along the Banks from Ocracoke Inlet to Cape Hatteras.
- Thursday, July 15. Meeting at Swan Quarter in a. m. for fishermen and oystermen from Hyde and parts of Beaufort and Pamlico counties.
- Friday, July 16. Meeting at Washington, Beaufort County.
- Saturday, July 17. Sail from Morehead City to Atlantic, examining Core Sound and Beaufort Harbor.
- Monday, July 19. Meeting at Beaufort. For the fishermen and oystermen from Carteret and part of Craven counties.
- Tuesday, July 20. Examination of conditions in Carteret County and Government Laboratory.
- Wednesday, July 21. Meeting at New Bern, Craven County.
- Thursday, July 22. Meeting at Jacksonville, Onslow County.
- Friday, July 23. Meeting at Wilmington, New Hanover County.
- Saturday, July 24. Meeting at Southport, Brunswick County.

The committee were accompanied on this trip by Dr. H. F. Moore, expert of the United States Bureau of Fisheries, and Dr. Joseph Hyde Pratt, State Geologist; and part of the time by T. H. Meekins, Fish Commissioner, and W. M. Webb, Oyster Commissioner. The Oyster Commission furnished the *Atlantic*, the boat belonging to that commission. Two stenographers, Miss H. M. Berry of Chapel Hill and Miss Sophia Busbee of Raleigh, were in attendance at all these meetings, and all the testimony and information was accurately recorded. These meetings were conducted similarly as if they had been held at Raleigh during the session of the General Assembly.

The first meeting was held at Edenton, July 7, 1909, Lieutenant Governor Newland presiding. In opening the meeting he said:

Gentlemen: We are here in obedience to a resolution passed by the State Legislature, hoping that we might, after visiting the waters in eastern North Carolina, make some recommendations to the next Legislature that would be beneficial to the fishing interests of the State. And I would say that in obedience to that resolution we are here to-day. The proceedings of this committee will be in the nature of a legislative report, and it is earnestly requested that every citizen here will give the committee all the information he has, in order that we may be informed. This is your meeting and you are wanted to talk. We are here to hear you, not for you to hear us, for, speaking for myself, I know nothing about the fishing interests. I came here absolutely ignorant and unbiased, and we are here to hear you and to hear recommendations, and I will now ask Judge Graham to give in detail the object of this meeting.

Judge A. W. Graham, Speaker of the House of Representatives, spoke as follows:

Mr. Chairman and Fellow-Citizens of Northeastern North Carolina:

There are some people in North Carolina who think the fish and oyster interests are mere local matters and that the great body of the State has nothing to do with it, and that only such laws should be passed as are recommended and endorsed by the people of that locality. I am one among those who believe that we all compose one grand old State; that what is to the interest of the people of Chowan is likewise to the interest of Granville. We are a great State. There are many industries in North Carolina that redound to the credit of the State, and would reflect much more credit to the State if they were thoroughly prosecuted. The manufacturing interests are more in the central part of the State, in which I live; also the mining regions are in the part where I live and where the Lieutenant Governor lives. The agricultural interests predominate in our State and are of joint interest to us all. The fishing interest, which I class second to none of them, is peculiarly the interest of this section of North Carolina, and it is one in which every true North Carolinian ought to take a deep interest, because we cannot benefit one portion of our State without all of us receiving some influences that tend to the upbuilding of our own State.

It has been my fortune, some say misfortune, like every other gentleman of the committee, to have been a member of the Legislature for many years. I have listened, with great interest, to the discussions of these oyster and fish problems by the members of the Legislature from this section, and from my observation and from the information that I have obtained from the gentlemen from this section of North Carolina, I believe that you have within your grasp one of the greatest interests of this State. There is another thing that I have observed, though, and that is that the fishermen are never agreed among themselves. It is a peculiar fact, and some of you would be struck with the force of the remark if you could go up to the Legislature and listen to the discussions of the various matters by the gentlemen composing these committees. But for the fact that they are all so in earnest, you would think there was a regular circus going on at these committee meetings. If you attempt to carry out the views of one person about this matter, in the eyes of another you ruin the fishing interest of North Carolina. That does not take place at one session of the Legislature, but at absolutely every session. It is very difficult to understand why such a state of affairs should exist. To the men of the mountains and of the piedmont it seems almost inexplicable until you study the question and see that the same law that would be applicable to one portion of North Carolina would not work and prove beneficial to the others, and also to realize the fact that some men in certain portions of a district want very stringent laws passed in regard to the fishing in North Carolina, and they will advocate the most stringent law possible, and then at the end of the bill they will have another clause inserted: "*Provided, this does not apply to County.*" Every fisherman wants the fishing law to apply to the county in which he does not live. But, I am glad to say, there seems to be more uniformity of sentiment; there seems to have been a broad-minded conception of the whole question aroused in this part of North

Carolina. After these matters were thoroughly discussed up there and the committees disagreed among themselves—and, mark you, that nearly every man on the committee was from this section of the State—it was thought best by those gentlemen that a commission be appointed in order to investigate these matters and recommend to the ensuing Legislature such laws as would be adapted to each section of the State and would not work an injustice to any.

So, upon a motion of a gentleman from this section, a resolution was presented authorizing the appointment of this committee, consisting of three members from the House of Representatives, one from the East, one from the Center, and one from the West, and the Speaker, and two members from the Senate, together with the President of the Senate. That is the reason the Lieutenant Governor and myself are here to-day. I will read this resolution. [Reads resolution.]

Now, gentlemen, we are here by virtue of that resolution. We are unfortunate in not having the services of Governor Doughton of Alleghany. He is a man of long experience in the Legislature and, you know, was for a while Lieutenant Governor. He is detained at home, and we will not have the benefit of his services. Mr. Currie of Cumberland is here; Senator Travis of Halifax is here; and Senator Barringer of Guilford will be here to-day. We come now with no preconceived ideas in regard to it. We are come with our minds open and unprejudiced, to talk with you, as brother to brother, because we are all interested in this matter. We are all now, as it were, in one great partnership. We want every man in this house, whether he is a professional man, whether he is a farmer, whether he is a fisherman or whether he is an everyday laborer, we want you all to feel that you have an interest in this matter, and to express your views freely to us to-day. Whatever tends to build up this grand section of northeastern North Carolina will certainly redound to the good of our State. We bespeak your hearty coöperation by giving advice and assistance, and if any man presents views that don't agree with the views of other gentlemen here, let us have a full and free discussion, because it is by rubbing together our minds that we will be able to reach some kind of a conclusion.

If you will take the map of North Carolina, examine and compare these waters of yours with the waters of Virginia, Maryland, and Connecticut, you will see that we have, perhaps, a greater area that could be rendered profitable, if proper laws were enacted, than any one of these States; but, unfortunately, I do not know what the reason is, last year Virginia made \$68,000 clear out of her fish and oysters; with not one-fourth the territory that you have here, Louisiana cleared \$18,000; and Connecticut, with not one-fourth the territory that you have, made \$38,000, while North Carolina went \$8,000 in debt. Is it in the administration of the law? Is it for the want of proper laws? What is the cause of these things?

I will say, though, that that loss was not in the conduct of the fish part, because we made a slight profit in the administration of the fish laws in North Carolina, but in the administration of the oyster laws in North Carolina we are now between \$8,000 and \$10,000 in debt, while other States have reaped a harvest.

At the conclusion of Judge Graham's remarks, Mr. Frank Wood of Edenton was called upon to read a paper which embodied the views of the fishermen of that section:

A thorough understanding by your committee of conditions in the fishing industry is greatly desired by us and we gladly offer any information we have to aid you to that end. The frequent appeals to the State for legislation for the protection of the industry is as distasteful and burdensome to us as it can be to the Legislature, and, with a view to avoiding that hereafter, two committees of practical fishermen met at Morehead in 1906 and 1908 and labored earnestly to agree upon a measure that would be acceptable to all; each side made concessions and the recommendations presented are the best obtainable. The fishing industry is of great value to our country and its maintenance of vital importance, not only because it is one of our chief sources of income, but because the shad and rock furnish a rare and valuable food supply to those who are able to pay high prices for delicacies at a season when they are rare and in best demand, and the herring supplies a good and wholesome food to our own people and our neighbors at lower prices than any other food of equal value can be bought for. These fish are all migratory and come into our waters to spawn, and here they find at the head of our sounds and rivers ideal conditions; they cannot spawn in cold, salt water, and must reach the warm, fresh water they find here. The legislation we sought for has been to open the inlets and middle of the sounds and rivers that these migratory fish may reach these waters, where our National Government has liberally aided nature in maintaining the supply of shad. The recommendations of the fishermen provide that in all sections the fishing shall be confined to certain distances from the shore, and the inlets and middle water be left open and free from obstruction. There was no difficulty in agreeing upon these recommendations, except at a few points in front of the inlets and the narrow parts of Croatan Sound. As can be seen on the charts, old and new, these points are directly in the line of passage of the fish to the spawning grounds, and are the most important points to be kept open. A very few nets can close them, and to permit fishing there will be to grant special privileges to a few and practically destroy the industry for the many. To these points we ask your special attention.

When the Legislature decided to postpone fish legislation until your investigation could be made, we did not expect any further consideration would be given to the matter; but a bill was passed just before the close of the session, without our knowledge or approval, which repealed the enforcing clause of the law and practically nullified all the legislation we have affecting the industry. The forbidden territory is definitely marked by the Vann law, and that law provided that nets set beyond the limits could be removed by the Fish Commissioner. But now it must be proven in a court of justice that the net is beyond the limit (a self-evident fact), and then the offender can be fined only \$50, while the privilege in many cases would be worth thousands of dollars to him.

If this committee can aid in the enforcement of the law until the enforcing clause of the Vann bill can be reinstated, it will be of great service to us.

To further show that our efforts have been for the advancement of the general fishing industry, I will ask you to note that one section of the recom-

mendations curtails our time for fishing, limits our territory, forbids the taking of certain small fish and forbids taking sturgeon at all for several years. All these recommendations were made by the fishermen, to maintain and replenish the supplies of fish, as it has become evident to us that the business is overdone and we will lose all unless changes are made.

At every meeting the question was asked, Do you think the best way to foster and develop the fishing industry of the State is to have all the counties interested in commercial fisheries under the jurisdiction of a Fish Commission? There was not a single meeting but that the sentiment expressed was to answer this question in the affirmative. The meetings also brought out the fact that practically no county was a unit as to what regulations would be best for the county, one fisherman wanting one thing and another something different, and in nearly every case the suggestions were for the benefit of a small community regardless of the effect on county or State.

At Manteo there were on exhibition the various kinds of nets and other apparatus that are used in fishing and oystering in North Carolina, thus enabling the members of the committee to become thoroughly familiar with fishing appliances.

These meetings were well attended and the fishermen entered heartily into the discussions and were very free in answering questions asked by members of the committee. The attendance at the meetings varied from forty to about three hundred. The information collected at these meetings was typewritten, and thus was readily accessible to each member of the committee.

1910 Itinerary of Fish Committee.

The second trip was made in March, 1910, and the fishermen were visited while actually engaged at their work. The following members of the committee met at Wilmington, March 14, 1910: A. W. Graham, R. A. Doughton, J. H. Currie, Dr. H. F. Moore, and Joseph Hyde Pratt. The committee were accompanied by Mr. E. H. Baker of Raleigh as stenographer.

The first trip was down the Cape Fear River, where the methods of catching and marketing the fish were closely observed. The fish markets of Wilmington were also inspected and information obtained regarding the size and value of fish marketed. The next stop was at Morehead City, where the fish markets were inspected. The Oyster Commissioner's boat, the *Atlantic*, carried the committee from Morehead City through Beaufort Harbor, Core Sound, and up Neuse River to New Bern, stopping en route at the Beaufort Laboratory, where the com-

mittee had an opportunity to inspect and eat some oysters taken from several of the beds that had been planted by the North Carolina Geological and Economic Survey. At the east end of Core Sound, where the night was spent, the location of natural and planted oyster bottoms were observed.

At New Bern the markets were inspected and considerable information was obtained from fishermen who brought their fish to market on that day. From New Bern to Washington the trip was made over the Norfolk Southern Railroad. At Washington the committee were met by Mr. T. S. Meekins, with the Fish Commission boat, *Gretchen*. After inspecting the fish markets at Washington, the committee was taken down Pamlico River and up Pungo River to Belhaven, where they spent Sunday. From Belhaven the committee crossed Pamlico Sound to Hatteras, having an opportunity there to study the location of nets and methods of fishing same in Hyde County and around Hatteras Inlet. The county line between Hyde and Dare counties passes through the center of Hatteras Inlet. On the Dare side the nets were set in accordance with the law, this county being under the Fish Commission, while on the Hyde County side of the line they were not. While en route from Hatteras to Manteo, Roanoke Island, the committee had a splendid opportunity to study conditions around Stumpy Point, the Ten Mile Limit, Roanoke Island, and New Inlet. The conditions in Albemarle Sound were studied while en route from Manteo to Edenton. At a number of places stops were made to enable the members of the committee to observe the methods of fishing pound and gill nets and seines. The conditions on Chowan River were also investigated.

Other Meetings of Committee.

During the latter part of the year 1911 several meetings of the committee were held in Raleigh in preparing its report. Several drafts were made and each member had an opportunity of going over these carefully. The report was finally unanimously adopted by the committee and sent to the Legislature, the report being introduced in the House by Mr. Doughton as House Bill No. 293. The bill was thoroughly discussed at joint meetings of the House and Senate committees on fish, which in turn appointed a subcommittee to draft a substitute bill that would embody the changes that the joint committees considered should be made. This bill was drafted, submitted to the members of the Legislative Fish Committee of the General Assembly of 1909 and accepted by them as a compromise bill, as it was endorsed by the Fish Committees of the House and Senate.

The following is a copy of the report made by the committee, and there is given in footnotes the sections that were changed by the joint committees, the changes being in italics:

A BILL TO BE ENTITLED "AN ACT TO ESTABLISH A FISHERIES COMMISSION AND TO PROTECT THE FISHERIES OF NORTH CAROLINA.*

The General Assembly of North Carolina do enact:

SECTION 1. That for the purpose of enforcing the laws relating to all commercial fish there is hereby created a Fisheries Commission, which shall consist of a commissioner and the Geological Board and the State Geologist, which said board and said State Geologist, in addition to their duties set forth in chapter 94, section 4432, volume 2 of the Revisal of 1905, shall be clothed with the powers and charged with the duties of enforcing the provisions of this act, and for that purpose shall be denominated the Fisheries Commission Board. The commissioner shall be appointed by the Governor within thirty (30) days after the passage of this act. The commissioner shall be responsible to the Fisheries Commission Board for carrying out of the duties of his office, and shall make semiannual reports to them at such time as they may require. The term of office of said commissioner and his successors in office shall be four years, or until their successors are appointed and qualified, and in case of vacancy in the office the appointment shall be to fill the vacancy. The said commissioner shall appoint two assistant commissioners, by and with the consent of the Fisheries Commission Board, one of whom shall be designated as Assistant Fish Commissioner and the other as Shellfish Commissioner. The aforesaid commissioner and assistant commissioners shall receive such pay as the Fisheries Commission Board shall determine. During the absence of the commissioner, or his inability to act, the Fisheries Commission Board shall appoint one of the assistant commissioners to have and exercise all the powers of the commissioner. The commissioner and assistant commissioners shall each execute and file with the Secretary of State a bond payable to the State of North Carolina in the sum of five thousand dollars for the commissioner and twenty-five hundred dollars for each of the assistant commissioners, with securities to be approved by the Secretary of State, conditioned for the faithful performance of their duties and to account for and pay over pursuant to law all moneys received by them in their office. The Fisheries Commissioner and assistant commissioners shall take and subscribe an oath to support the Constitution and for the faithful performance of the duties of his office, which oaths shall be filed with their bonds. The assistant commissioners may be removed for cause by the commissioner, who may appoint their successors.¹

*House Bill No. 293, Regular Session 1911. Introduced by Representative Doughton.

¹The following sections were in the substitute bill for section 1 of the report of the Legislative Fish Committee:

SECTION 1. *That for the purpose of enforcing the laws relating to all commercial fish there is hereby created a Fisheries Commission, which shall consist of the State Geologist and four members appointed by the Governor from the several fishing districts of the State, who, together with the State Geologist, shall be denominated the "Fisheries Commission Board." The members shall be appointed as follows, viz.: two, whose terms of office shall expire on the first day of June, one thousand nine hundred and thirteen, and two whose terms of office shall expire on the first day of June, one*

SEC. 2. *Inspectors.*¹—The Fisheries Commissioner may appoint, with the approval of the Fisheries Commission Board, inspectors in each county having fisheries under his jurisdiction, who will assist him at such times as he may require. The said inspector shall serve under the direction of the commissioner, receiving compensation not to exceed three dollars per day and necessary expenses while in actual service.

SEC. 3. *Office and Clerical Force.*²—The Fisheries Commissioner shall rent and equip an office, which will be adequate for the business of the commission, in some town conveniently located to the maritime fisheries, and he is authorized to employ such clerks and other employees as may be necessary for the proper carrying on of the work of his office, by and with the consent of the Fisheries Commission Board.

SEC. 4. *Equipment.*³—The Fisheries Commissioner is authorized, by and with the consent of the Fisheries Commission Board, to purchase or rent such boats, nets, and other equipment as may be necessary to enable him and his assistants to fulfill the duties specified in this act.

SEC. 5. *Duties.*—The commissioner shall enforce all acts relating to the fish and fisheries of North Carolina; he shall, by and with the advice and consent of the Fisheries Commission Board, make such regulations as shall maintain open for the passage of fishes all inlets and not less than one-third of the width of all sounds and streams, or such greater proportions of their width as may be necessary; he shall collect and compile statistics showing the annual product of the fisheries of the State, the capital invested and the apparatus employed, and any fisherman refusing to give these statistics shall be refused a license for the next year; and the Fish Commissioner shall prepare and have on file in his office maps based on the charts of the United

thousand nine hundred and fifteen; and their successors shall be appointed by the Governor for a term of four years each thereafter. The four members shall receive four dollars per day each and traveling expenses while attending meetings of the board: Provided, that the per diem and expenses shall not exceed two hundred and fifty dollars each per annum.

That said board shall appoint a Fish Commissioner within thirty days after the passage of this act, and the said commissioner shall be responsible to the Fisheries Commission Board for carrying out the duties of his office, and shall make semiannual reports to them at such time as they may require. The terms of office of said commissioner and his successors in office shall be four years, or until their successors are appointed and qualified; and in case of vacancy in the office, the said board shall appoint for the unexpired term of said commissioner. The Fisheries Commission Board shall appoint two assistant commissioners, one of whom shall be designated as Assistant Fish Commissioner and the other as Shellfish Commissioner. The aforesaid commissioner and assistant commissioners shall receive such pay as the said Fisheries Commission Board shall determine. During the absence of the commissioner, or in case of his inability to act, the said board shall appoint one of the assistant commissioners to have and exercise all the powers of the commissioner. The said commissioner shall execute and file with the Secretary of State a bond payable to the State of North Carolina in the sum of five thousand dollars and the two assistant commissioners shall each file a bond with the Secretary of State in the sum of twenty-five hundred dollars, conditioned for the faithful performance of their duties, and to account for and pay over pursuant to law all moneys received by them in their office. The said commissioner and assistants shall take and subscribe an oath as is required of the Fisheries Commission Board, which oath of office shall be filed with their bonds. The said commissioner and assistants may be removed from office for cause by the said Fisheries Commission Board, whose duty it shall be to appoint their successors in case of such removal.

²These three sections same in substitute.

States Coast and Geodetic Survey, of the largest scale published, showing as closely as may be the location of all fixed apparatus employed during each fishing season; he shall have surveyed and marked in a prominent manner those areas of waters of the State in which the use of any or all fishing appliances are prohibited by law or regulation, and those areas of waters in the State in which oyster tonging or dredging is prohibited by law; he shall prosecute all violations of the fish laws, and whenever necessary he may employ counsel for this purpose; he shall seize and remove all nets or other appliances set or being used in violation of the fisheries laws of the State, advertise same for twenty days at the courthouse and three other public places, and sell same at public auction at such place as the Fisheries Commissioner shall designate, in the county in which seizure was made, and apply the proceeds of sale to payment of cost and expenses of such removal and sale, and pay any balance remaining into the State Treasury to the credit of the school fund of the county in which the seizure was made; he shall, in an official capacity, have power to administer oaths and to send for and examine persons and papers; he shall be responsible for the collection of all license fees, taxes, rentals, or other imposts on the fisheries, and shall pay same into the State Treasury to the credit of the Fisheries Commission fund; he shall, on or before the twenty-fifth day of each month, mail to the Treasurer of the State a consolidated statement showing the amount of taxes and license fees collected during the preceding month, and by and from whom collected; he shall carry on investigations relating to the migration and habits of the fish in the waters of the State, also investigations relating to the cultivation of the oyster, clam, and other mollusca, and of the terrapin, lobster, and crab, and for this purpose he may employ such scientific assistance as may be authorized by the Fisheries Commission Board.²

²This section in the substitute bill was as follows:

SEC. 5. DUTIES.—*The commissioner shall have authority to enforce all acts relating to the fish and fisheries of North Carolina; he shall by and with the advice and consent of the Fisheries Commission Board, make such regulations as shall maintain open for the passage of fishes all inlets and not less than one-third of the width of all sounds and streams; he shall collect and compile statistics showing the annual product of the fisheries of the State, the capital invested and the apparatus employed, and any fishermen refusing to give these statistics shall be refused a license for the next year; and the Fish Commissioner shall prepare and have on file in his office maps based on the charts of the United States Coast and Geodetic Survey, of the largest scale published, showing as closely as may be the location of all fixed apparatus employed during each fishing season; he shall have surveyed and marked in a prominent manner those areas of waters of the State in which the use of any or all fishing appliances are prohibited by law and those areas of water of the State in which oyster tonging or dredging is prohibited by law; he shall prosecute violations of the fish laws, and whenever necessary he may employ counsel for this purpose; he shall, in an official capacity, have power to administer oaths and to send for and examine persons and papers; he shall be responsible for the collection of all license fees, taxes, rentals, or other imposts on the fisheries, and shall pay same into the State Treasury to the credit of the Fisheries Commission fund; he shall, on or before the twenty-fifth day of each month, mail to the Treasurer of the State a consolidated statement showing the amount of taxes and license fees collected during the preceding month, and by and from whom collected; he shall carry on investigations relating to the migration and habits of the fish in the waters of the State, also investigations relating to the cultivation of the oyster, clam, and other mollusca, and of the terrapin, lobster, and crab, and for this purpose he may employ such scientific assistance as may be authorized by the Fisheries Commission Board.*

SEC. 6. Arrests Without Warrant; When and How Made.—The Fisheries Commissioner, assistant commissioners and inspectors, shall have power with or without warrants to arrest any person or persons violating any of the fishery laws, who shall be carried before a magistrate for trial according to section three thousand one hundred and eighty-two of the Revisal of one thousand nine hundred and five.⁴

SEC. 7. Power to Take Fish.—The Fisheries Commissioner and the United States Bureau of Fisheries may take and cause to be taken for scientific purposes, or for fish culture, any fish or other marine organism at any time from the waters of North Carolina, any law to the contrary notwithstanding; and may cause or permit to be sold such fishes or parts of fishes so taken as may not be necessary for purposes of scientific investigations or fish culture: *Provided*, that in taking fish for fish culture in the hatcheries of this State the fish shall only be taken while the hatcheries are in operation and only between the hours of 4 and 11 p. m.⁵

SEC. 8. No Interest in Fisheries.—The members of the Fisheries Commission Board, the Fisheries Commissioner, assistant commissioners and inspectors, shall not be financially interested in any fishing industry in North Carolina.⁶

SEC. 9. Revenue.—All license fees, taxes, rentals of bottoms for oyster or clam cultivation and other imposts upon the fisheries, in whatever manner collected, shall, except as otherwise provided in this act, be deposited with the State Treasurer to the credit of the Fisheries Commission fund, to be drawn upon as directed by the Fisheries Commission Board.⁷

SEC. 10. License to Fish and to Catch Oysters.—Each and every person, firm, or corporation, before commencing or engaging in any kind of fishing in the State, shall file with an inspector of the county in which he desires to fish, or with the Fisheries Commissioner, or one of his assistant commissioners, a sworn statement as to the number and kind of nets, seines, or other apparatus intended to be used in fishing. Upon filing this sworn statement on oath the Fisheries Commissioner shall issue, or cause to be issued, to the said party or parties a license as prescribed by law; said applicant shall pay a license fee equal in amount to the fee or tax prescribed by law for fishing different kinds of apparatus in the waters of the State of North Carolina, or for tonging or dredging for oysters, as the case may be. The Fisheries Commissioner shall keep in a book especially prepared for the purpose an exact record of all licenses, to whom issued, the number and kinds of nets, boats, and other apparatus licensed, and the license fees received. He shall furnish to each person, firm, or corporation in whose favor a license is issued a special tag which will show the license number and number of pound nets, or yards of seine, or yards of gill-net that the licensee is authorized to use, and the licensee shall attach said tag to the net in a conspicuous manner satisfactory to the Fisheries Commissioner. All boats or vessels licensed to scoop, scrape, or dredge oysters shall display on the port side of the jib, above the reef and bonnet and on the opposite side of mainsail, above all reef points, in black

⁴This section in substitute was as follows:

ARRESTS WITHOUT WARRANT; WHEN AND HOW MADE.—*The Fisheries Commissioner, assistant commissioners and inspectors, shall have power with or without warrants to arrest any person or persons in the act of violating any of the fishery laws, who shall be carried before a magistrate for trial according to section three thousand one hundred and eighty-two of the Revisal of one thousand nine hundred and five.*

⁵This section the same in the substitute.

⁶Same in substitute.

letters, not less than twenty inches long, the initial letter of the county granting the license and the number of said license, the number to be painted on canvas and furnished by the Fisheries Commissioner, for which he shall receive the sum of fifty cents. Any boat or vessel used in catching oysters without having complied with the provisions of this section may be seized, forfeited, advertised for twenty days at the courthouse and two other public places in the county where seized, and sold at some public place designated in the advertisement, and the proceeds, less the cost of the proceedings, shall be paid into the school fund. The licenses to fish with nets shall all terminate on December thirty-first. Any person who shall willfully use for commercial fishing purposes any kind of net whatever, without having first complied with the provisions of this section, shall be guilty of a misdemeanor and, upon conviction, shall be fined twenty-five dollars for each and every offense.⁷

SEC. 11. *License for Boat Used in Catching Oysters.*—The Fisheries Commissioner, or Shellfish Commissioner, or inspector, may grant license for a boat to be used in catching oysters upon application made, according to law, and the payment of a license tax as follows: On any boat or vessel without cabin or deck, and under custom-house tonnage, using scoops, scrapes, or dredges, measuring over all twenty-five feet and under thirty, a tax of three dollars; fifteen feet and under twenty-five feet, a tax of two dollars; on any boat or vessel with cabin or deck and under custom-house tonnage, using scrapes or dredges, measuring over all thirty feet or under, a tax of five dollars; over thirty feet, a tax of six dollars; on any boat or vessel using scoops, scrapes, or dredges required to be registered or enrolled in the custom house, a tax of one dollar and fifty cents a ton on gross tonnage. No vessel propelled by steam, gas, or electricity, and no boat or vessel not the property absolutely of a citizen or citizens of this State, shall receive license or be permitted in any manner to engage in the catching of oysters anywhere in the waters of this State.⁸

SEC. 12. *Fishing for Menhaden With Purse Nets.*—Whenever any person or persons, corporation or corporations, may intend to take menhaden (fat-backs), porgies, herring, or other fish in any waters within the jurisdiction of this State, including the waters of the Atlantic Ocean within three nautical miles of the coasts of said State, either on his own account and benefit or on account and benefit of his employer, with purse or shirred nets, such person or persons, corporation or corporations, shall make an application to the Fisheries Commissioner for a license, and, upon the receipt of such application, the Fisheries Commissioner shall, upon the receipt of a sum equal to two dollars for each ton of the net tonnage of each vessel employed in such fishing, said net tonnage to be determined by custom-house measurement, as a license fee, issue to such person or persons, corporation or corporations, a license duly signed by the Fisheries Commissioner, which said license shall be valid and in force for the term of one year; all such licenses to be dated from January first, and no license shall be for a space of time less than one year. For every violation of this act the offending person or persons, corporation or corporations, shall be guilty of a misdemeanor and be fined two hundred dollars for each and every offense.⁹

⁷Same in substitute, except last two lines, which read: "and upon conviction, shall be fined not less than five dollars nor more than fifty dollars for each and every offense."

⁹These sections 11 and 12 are the same in the substitute, except that the license tax is in each case one dollar less.

SEC. 13. Purchase Tax.—All dealers in oysters and all persons who purchase oysters for canning, packing, shucking, or shipping, shall pay a tax of two cents on every bushel of oysters purchased by them, or caught by them, or by any one for them: *Provided*, that no oyster shall be twice taxed. This tax shall be paid to and collected by the inspectors, and, when paid, a receipt shall be given therefor. Upon failure or refusal by any person, firm, or corporation to pay said tax, his license as a dealer shall at once become null and void, and no further license shall be granted him during the current year; and it shall be the duty of the commissioner, assistant commissioner, or inspector to institute suit for the collection of said tax. Such suit shall be in the name of the State of North Carolina on relation of the commissioner or of the inspector at whose instance such suit is instituted, and the recovery shall be for the benefit and to the use of the general Fisheries Commission fund.*

SEC. 14. License Tax.—The following license tax is hereby levied annually upon the different fishing appliances used in the waters of North Carolina:

Anchor gill-nets, twenty cents per one hundred yards or fraction thereof.

Stake gill-nets, ten cents per one hundred yards or fraction thereof.

Drift gill-nets, twenty cents per one hundred yards or fraction thereof.

Pound-nets, one dollar each.

Seine, drag-nets, and mullet nets under one hundred yards, one dollar each.

Seine, drag-nets, and mullet nets over one hundred yards and under three hundred yards, one dollar per one hundred yards or fraction thereof.

Seine, drag-nets, and mullet nets over three hundred yards and under one thousand yards, one dollar and twenty-five cents per one hundred yards or fraction thereof.

Seine, drag-nets, and mullet nets over one thousand yards, one dollar and seventy-five cents per one hundred yards or fraction thereof.

Fyke-nets, twenty-five cents each.

Tonging for oysters, the license tax shall be one dollar for each tonger.¹⁰

*This section in the substitute is as follows:

PURCHASE TAX. All dealers in oysters, and all persons who purchase oysters for canning, packing, shucking, or shipping, shall pay a tax of two cents on every bushel of oysters purchased by them, or caught by them, or by any one for them, except coon oysters, which shall be taxed one cent per bushel: *Provided*, that no oyster shall be twice taxed. This tax shall be paid to and collected by the inspectors, and, when paid, a receipt shall be given therefor. Upon failure or refusal by any person, firm, or corporation to pay said tax, his license as a dealer shall at once become null and void, and no further license shall be granted him during the current year; and it shall be the duty of the commissioner, assistant commissioner, or inspector to institute suit for the collection of said tax. Such suit shall be in the name of the State of North Carolina on relation of the commissioner or of the inspector at whose instance such suit is instituted, and the recovery shall be for the benefit and to the use of the general Fisheries Commission fund.

¹⁰**LICENSE TAX.** The following license tax is hereby levied annually upon the different fishing appliances used in the waters of North Carolina:

Anchor gill-nets, twenty cents per hundred yards or fraction thereof.

Stake gill-nets, ten cents per hundred yards or fraction thereof for all nets in excess of three hundred yards.

Drift gill-nets, twenty cents per hundred yards or fraction thereof.

Pound-nets, one dollar each.

Seine, drag-nets, and mullet nets over three hundred yards and under one thousand yards, one dollar per hundred yards or fraction thereof.

Seine, drag-nets, and mullet nets over one thousand yards, one dollar and fifty cents per hundred yards or fraction thereof.

SEC. 15. *Reports.*—The Fisheries Commission Board shall cause to be prepared and submitted to each Legislature a report showing the operations, collections, and expenditures of the Fisheries Commission; it shall also cause to be prepared for publication such other reports, with necessary illustrations and maps, as will adequately set forth the results of the work and the investigations of the Fisheries Commission, all such reports, illustrations, and maps to be printed and distributed at the expense of the State, as are other public documents, as the Fisheries Commission Board may direct.¹¹

SEC. 16. *Appropriation.*—There is hereby appropriated out of the General Treasury as a supplementary fund the sum of ten thousand dollars annually for four years, or as much thereof as may be needed, to the Fisheries Commission to carry out the work of the commission in the protection and promotion of the fisheries of the State, this sum to be repaid to the General Treasury by the Fisheries Commission when it shall be on a self-sustaining basis, said sum to be used and expended as directed by the Fisheries Commission Board, and any part of it that may be required may be used for purchasing boats and other equipment necessary to carry out the work of the commission; and any money that may be in the State Treasury to the credit of the Fish Commission and Oyster Commission fund on the day that this act becomes effective shall be transferred by the State Treasurer to the credit of the Fisheries Commission fund, and the Fisheries Commission Board is hereby authorized to pay out of the Fisheries Commission fund all just claims that may be outstanding against the Fish or Oyster Commissions.¹¹

SEC. 17. *Transfer of Equipment.*—All boats, fishing and oyster tackle, office supplies, stationery, and all other supplies of whatever character belonging to the Fish Commission and Oyster Commission shall be transferred to the Fisheries Commissioner for the use of the Fisheries Commission.¹¹

SEC. 18. *Jurisdiction of State.*—The State of North Carolina shall have exclusive jurisdiction and control over all the commercial fisheries of the State wherever located.¹¹

SEC. 19. It shall be unlawful to place in any of the waters of this State any dynamite, giant or electric powder, or any explosive substance whatever, or any drug or poisoned bait, for the purpose of taking, killing, or injuring fish. And any one violating this section shall be guilty of a misdemeanor and shall, upon conviction, be fined or imprisoned in the discretion of the court.¹¹

SEC. 20. It shall be unlawful to discharge or to cause or permit to be discharged into the waters of the State any deleterious or poisonous substance or

Fyke-nets, twenty-five cents each.

Tonging for oysters, the license tax shall be one dollar for each tonger.

Any person who shall engage in fishing with any of the above-named nets or appliances for commercial purposes, without first procuring the license therefor, shall be guilty of a misdemeanor, and upon conviction shall be fined not more than fifty dollars or imprisoned not more than thirty days.

That any person desiring to engage in the business of purchasing fish for shipment and not for retailing shall first procure a license from the Fisheries Commission Board, for which a charge of ten dollars shall be paid, and said dealer shall keep a true account of all amounts paid for fish to be supplied, and shall make a verified statement at the end of each month of the total amount bought, and shall remit to the Fisheries Commission Board with said monthly report a tax at the rate of one dollar per one thousand dollars in such purchases made by him: Provided, that a second tax on purchases shall not be paid. Any dealer failing to procure license, or any dealer failing to make true and accurate statement of purchases, as required, shall upon conviction be guilty of a misdemeanor, and his license shall be revoked for one year.

substances inimical to the fishes inhabiting the said waters; and any person, persons, or corporation violating the provisions of this section shall be guilty of a misdemeanor and, upon conviction, be fined or imprisoned in the discretion of the court.¹¹

SEC. 21. The Fisheries Commission Board is hereby authorized to regulate, prohibit, or restrict, in time, place, character, and dimensions, the use of nets, appliances, apparatus, or means employed in taking or killing fish; to regulate the seasons at which the various species of fish may be taken in the several waters of the State, and to prescribe the minimum sizes of fish which may be taken in the said several waters of the State; and such regulations, prohibitions, restrictions, and prescriptions, after due publication, shall be of equal force and effect with the provisions of this act; and any person violating the provisions of this section shall be guilty of a misdemeanor, and upon conviction shall be fined or imprisoned at the discretion of the court: *Provided, however*, that if a petition signed by five or more voters of the district or community which will be affected by the proposed change is filed with the Fisheries Commission Board through the Fisheries Commissioner, assistant commissioners, or inspectors, asking that they have a hearing before any proposed change in the territory, size of mesh, length of net, or time of fishing shall go into effect, petitioning that they be heard regarding said change, the Fisheries Commission Board shall in that event designate by advertisement for a period of thirty days at the courthouse and three other public places in the county affected, and also by publication in a newspaper of the county, if such is published in said county, for two consecutive weeks, a place at which said board will meet and hear argument for and against said change, and may ratify, rescind, or alter this previous order of change as may seem just in the premises.¹²

SEC. 22. Any person or persons removing, injuring, defacing, or in any way disturbing the posts, buoys, or any other appliances used by the Fisheries Commission in marking the restricted areas relating to any and all fishing, or marking other areas in which oyster tonging or dredging is prohibited by law, and those marking oyster bottoms that are leased for oyster cultivation, shall be guilty of a misdemeanor and, upon conviction, shall be fined or imprisoned at the discretion of the court.¹³

SEC. 23. Wherever the word fish or fishes used as a substantive occurs in this act it shall be construed to include porpoises and other marine mammals, fishes, mollusca, and crustaceans, and wherever the word fishing or fisheries occurs it shall be construed to include all operations involved in using, setting, or operating apparatus employed in killing or taking the said animals or in transporting and preparing them for market.¹⁴

¹¹This section is the same in substitute.

¹²This section was left out of the substitute bill, but the following was added as a new section:

That it shall be unlawful for any person, firm, or corporation in this State to catch for market or compost, ship, buy or sell, or to have in his possession for sale, any mullet of less than eight inches in length; any trout, bluefish or tailor, drum, sea-mullet, or kingfish, flounder, mackerel, or rock of less than nine inches in length; or any spots, hogfish, or croakers of less than six inches in length; any butterfish or starfish less than five inches in length. That any person, firm, or corporation violating the provisions of this section shall be guilty of a misdemeanor, and upon conviction or confession shall be fined not more than fifty dollars or imprisoned not more than thirty days.

¹³This section the same in substitute.

SEC. 24. That all acts relating to the commercial fisheries of North Carolina are hereby amended so that the words "Shellfish Commissioner," "Oyster Commissioner," or "Fish Commissioner" shall read "*Fisheries Commissioner*"; and the words "Shellfish Commission," "Oyster Commission," or "Fish Commission" shall read "*Fisheries Commission*."¹³

SEC. 25. All laws and clauses of laws in conflict with this act are hereby repealed.¹⁴

SEC. 26. That this act shall be in force from and after its ratification.¹⁴

It will be interesting at this time to give the opinion of the United States Bureau of Fisheries on the report of the committee, and this opinion was made a part of the report to the General Assembly of 1911:

DEPARTMENT OF COMMERCE AND LABOR

BUREAU OF FISHERIES

WASHINGTON

November 28, 1910.

DR. JOSEPH HYDE PRATT, *State Geologist*,
Chapel Hill, N. C.

SIR:—The Bureau acknowledges the receipt of your letter of November 15, submitting for criticism the report of the joint legislative committee on fishery matters which will be transmitted to the North Carolina Legislature of 1911. The Bureau has examined the proposed laws with care, and is pleased to observe that they have both the breadth and flexibility essential to meet the conditions obtaining in North Carolina. The provision for a single commissioner accountable to a board already established, and which has demonstrated its efficiency in connection with the Geological Survey, is regarded as excellent. It centralizes the administration of the fisheries regulations, while at the same time placing at the service of the commissioner the advice, and, if need be, the control, of a body free from bias and local association with the fishing communities.

Safeguarded by this provision, the commissioner properly is given a wide discretion concerning the details of the regulations. While the broad principle of State control of the fisheries is in the opinion of the Bureau the only plan that will prove of lasting value, it is essential that recognition be made of the fact that identical regulations as to nets, close seasons, etc., are not applicable to all localities. After some experience and investigation the commissioner will be in an unequaled position to recommend such regulations as will meet the local requirements and conditions. In respect to this, the Bureau believes that the proposed law is superior to the systems applied in other States and equal to that which has demonstrated its efficiency in the Dominion of Canada. The Bureau is pleased also that there is proposed statutory recognition of the principle of an open channel for the access of fish to the upper waters. The success of the application of this principle to the upper sounds

¹³This section read as follows in the substitute:

That this act shall be in force from and after June first, one thousand nine hundred and eleven.

of North Carolina has been attested by an improvement in the fishery and in the increase of the take of shad eggs at Edenton hatchery from six and a half millions in 1905 to seventy millions in 1910.

The oyster regulations do not appear to be materially changed, but the consolidation of the oyster commission with the fishery commission is in the interest of economy and efficiency of administration.

The Bureau feels that it can properly endorse the conclusions of the committee, and expresses the hope that they may be enacted into law for the benefit of not only the fishing communities, but the State of North Carolina as a whole.

Respectfully,

H. M. SMITH,
Acting Commissioner.

The bill carried an appropriation, and was reported favorably by the committee on appropriations.

This substitute bill, after considerable debate, passed the House without amendment; but when it came up in the Senate it was so amended that it did not apply to certain counties, and after the amendments were passed the bill was defeated.

To satisfy a very few, and out of *senatorial courtesy*, a State-wide bill was allowed to be defeated, and a large and important State industry was permitted not only to be retarded in its growth, but to actually decline. It was a severe blow to the fishing industry of North Carolina; but those who have the interest of the State of North Carolina at heart and are thoroughly familiar with the dangers that beset this industry are harder at work than ever to create a sentiment for the protection and perpetuation of fishing industries. They realize that they must carry on a campaign of education; that the fishermen must be given accurate information as to what the protection of these industries will mean to them, and that the measures advocated are absolutely necessary if they and their children are to continue to make a livelihood out of fishing; and the citizens, indeed, must have the information that will show them that the fish and oysters are decreasing; that the industries are growing less and less, and what could be made a most flourishing industry in the State is becoming less and less every year; that what is a State industry and a State problem has been considered purely as a local problem; that an asset which belongs to all the people is being destroyed by a few.

North Carolina, with its great extent of salt and fresh waters, should be near the top of the list of the Atlantic States in value of its fish industry. Instead it stands eleventh. Massachusetts is first, Virginia second, Maryland fifth, and even little Connecticut comes ninth.

We can build up this industry if we will carry out similar measures to those that other States have carried out.

The New Bern Journal, in discussing this question, says:

"There is a chance to revive this business, to make the fishing industry of North Carolina a profitable and permanent one; but it will not come through the political methods which have been pursued. The demand is for a State Fish Commission that is beyond politics, that will be practical, unbiased and honest; that will place all counties under one general law, place the fishermen upon equal terms, and see to it that the fish are protected, caught when marketable and kept from destruction when not marketable.

"North Carolina's fish and oyster industries call for rational and business-like treatment, removed from politics, and when they are, it means many thousands of dollars to the people of this section where none are received to-day. The Fisheries Committee are on the right track, and its report before the next Legislature will be all-important to Eastern Carolina."

It is possible to protect and perpetuate our fish and oyster industries by the enactment and enforcement of adequate laws. It seems to be the consensus of opinion of those who have made a thorough study of the fish industries, that the only method of enforcing the laws regulating fishing and of fostering this industry is through the operation of the Fish Commission. The work of such a commission goes beyond that of simply enforcing the laws; it should carry on investigations relating to the various fishing industries; study local conditions, and be able to render a just decision regarding what is the best thing to be done in relation to the perpetuation of the oyster and any type of fish to the best interests of the State. As has been stated before, up to the present time these questions have been considered locally, while they should be considered a State question, and the best results can only be obtained when they are thus considered.

As the oyster industry in North Carolina is practically dependent upon the cultivation of the oyster, there is given below a short paper on the cultivation of the oyster in North Carolina, which gives briefly a history of the work that has been done along this line, together with the possibilities that are open to those who take up the cultivation of the oyster as a business.

CULTIVATION OF THE OYSTER IN NORTH CAROLINA.

One of the most important problems that confronts North Carolina at the present time, in connection with the development of its fisheries, is that relating to the cultivation of the oyster. Not only is the cultivation of the oyster necessary in order to increase the oyster industry of the State, but the life of the industry itself and the preservation of the natural oyster rocks are dependent upon the cultivation of the oyster in the waters of this State.

Personally, I know but little regarding oyster culture; but, as head of the Department in North Carolina which has been authorized by the Legislature to have made thorough and exhaustive investigations in regard to the fishing industries of the State, we have had considerable work done on questions relating to oyster culture. For this work we have very fortunately been able to obtain the services of men who were qualified to take up the investigations which the State Geological Survey desired to have made, the first investigations having been made by Dr. Caswell Grave and the later ones by Dr. Robert E. Coker. To these investigations the Survey is very much indebted for their very able and conscientious work on the problems relating to oyster culture.

Dr. Grave's work was confined principally to the waters in the vicinity of Beaufort, North Carolina, and the plants that he made were in Newport and North rivers. With the assistance of the steamer *Fish Hawk*, of the United States Bureau of Fisheries, Dr. Grave also made some investigations relating to the condition of the natural oyster rocks in Pamlico Sound and tributaries, and collected considerable information regarding the salinity of the water, the food supply for the oyster, and the direction and velocity of the currents. The results of Dr. Grave's experiments were satisfactory, although both in a negative and a positive way he states:

"Several important facts have been demonstrated which cannot fail to have a bearing upon any future operations in oyster culture in North Carolina. The lower parts of Newport and North rivers are not adapted to oyster culture. Oysters grow there in abundance when supported above the mud, but there is too much uncertainty connected with the crop to justify practical planting operations. When the time comes to place the oysters on the market they are too often not in salable condition. This is traceable to the high density of the water of these portions of the rivers. Should the industry in Pamlico Sound ever be developed to such an extent as to create a demand for seed oysters, however, the ground in the lower parts of these rivers will become valuable, for when cultch is exposed a good catch of spat is almost a certainty.

"The upper parts of the rivers, on the other hand, are well adapted to oyster planting, and, during all but the very dry seasons, there is every reason to believe that planters would be able to market their crop. The industry could never be extensive on account of the small amount of available ground, but between the natural beds there are many acres that might be utilized for purposes of planting. The natural beds themselves, if strewn with shells at some time during the summer months, could easily be made to yield many times the amount of oysters that is annually taken from them. They are public property, and no individual can be expected to be so public spirited as to plant the shells, but it might be done by the State, in one instance at least, as an experiment."

This work of Dr. Grave on oyster culture was begun in April, 1900, and extended over a period of about three years. As is seen from the

statement made above, these experiments showed that a marketable oyster (except for seed) could not be grown in the lower waters of either Newport or North rivers, but that the upper waters of both these rivers were very favorable for oyster culture. As, however, there was practically no demand for seed oysters, and as the areas in the upper portion of the rivers available for oyster culture were very limited, there was but very little advance made in oyster culture in North Carolina as a direct result of this work. If the work of the Survey on oyster culture had ceased with the experiments of Dr. Grave, we would have been of no great assistance to the oyster culturists in this State. Dr. Grave, however, had called attention to the need of carrying on experiments in Pamlico Sound, and that if the waters and bottoms were suitable for oyster culture, there would be large areas available for this purpose.

On account of the success of Dr. Grave's work in Newport and North rivers, it was deemed advisable to try larger plants and the greater variety of bottoms which were offered by Pamlico Sound. These investigations were made by Dr. Robert E. Coker, and the results, as a whole, were very satisfactory. Experimental plants were made on different bottoms in the various localities, in order to ascertain by actual trial what methods best suited particular regions or bottoms; and these beds were visited at intervals of a few months for the purpose of collecting data regarding the set of spats, rate of growth, density of water, and other biological and physical conditions. These beds were kept under observation fairly regularly for a period of four years, and proved rather conclusively that there are large areas in Pamlico Sound that are suitable for the cultivation of the oyster, and that this can be done profitably.

Oyster culture is not a new idea in North Carolina, for as early as 1840 oyster culture had been carried on in a small way for private purposes, but it was not until 1884 that there was any special attempt made to take up oyster culture commercially; and this was due to the passage of an act by the Legislature of 1883 which authorized the taking up of bottoms (except those in Pamlico Sound) for private cultivation of the oyster. There was little or no success attending the efforts of those who took out grants for oyster bottoms, and within a couple of years there were but very few acres under cultivation. In 1887-88 a survey, known as the Winslow Survey, was made of Pamlico Sound and tributaries which was supposed to show the location of the natural oyster rocks, and the bottoms not included within the boundary of the survey were supposed to be free from oyster rocks and open for lease for the purposes of oyster culture. Many thousands of acres of the bottoms of Pamlico

Sound and tributaries were taken up, and it looked as though oyster culture in North Carolina would be placed upon a firm foundation. Owing to one cause or another, however, which will be discussed later, the efforts of the planters were almost complete failures, and the cause of oyster culture in this State received a setback from which it is only just recovering.

Many people have believed that certain of the bottoms of Pamlico and Core sounds and their tributaries were favorable locations for oyster culture, but this had not been definitely proved until the experiments and investigations that were carried on by Drs. Grave and Coker had yielded results. Without knowing the conditions as they existed in eastern North Carolina, one would have supposed that after the results of these investigations had been published that oyster cultivation would have begun on a large scale. The reason that this was not done was that the people have not forgotten the losses that were sustained between 1880 and 1895. It might be well to discuss briefly the main reasons why the planters were not successful in cultivating the oyster during this period. In the first place, those who started to cultivate the oyster on a commercial scale did not make a thorough examination of the bottoms where they made their plants, and in many instances made no examination whatever as to the suitability of the locality for oyster culture. They simply took out a grant for a certain number of acres, and dumped a certain number of bushels of oyster shells, or, in some cases, seed oysters on these bottoms, and expected that nature would build up for them within a short time a profitable oyster rock. Others took out grants for large areas of bottoms in Pamlico Sound, not for the purpose of oyster cultivation, but for the purpose of speculation, expecting to resell their grants at a large profit. This latter set of men, in reselling or releasing their grants, called them oyster bottoms, and some of those purchasing the same took it for granted that they were obtaining suitable bottoms for oyster culture, but which they found out later were not in any way adapted to this purpose. The losses sustained by these men, though not very large individually, amounted to a considerable sum in the aggregate, and each one who did lose became a bitter opponent to oyster culture; though, in most cases, their loss was due to the fact that they had not selected suitable bottoms for planting, nor done their planting in a thorough manner.

Others, who desired to cultivate the oyster, made a thorough study of the question, took out grants on bottoms that were suitable for this purpose, planted shells or seed oysters in the most approved manner, and got beds started that began to yield very abundantly. They were not, however, allowed to reap the benefit of their labor, inasmuch as the

law governing oyster culture was not adequate to protect them. All that was necessary to cause these bottoms, which had been successfully cultivated, to revert back to the State was for two or more witnesses to appear before the court and swear that these bottoms had contained oysters before cultivation had begun, and that oystermen in that vicinity were accustomed to take oysters off of them. Thus, when the oyster culturist attempted to obtain a verdict against any one for obtaining oysters off of his cultivated beds, he found that the verdict was always against him instead of for him, and as a result of this verdict his bed was declared a natural rock, and, therefore, a public oyster ground. This continued year after year, and by 1900 practically all of the cultivated beds had been abandoned, except a very few acres that are still being cultivated for private use.

Thus, the North Carolina Geological and Economic Survey had two problems to solve: first, whether the cultivation of the oyster in the waters of Pamlico and Core sounds and their tributaries was practicable on a commercial scale; and also whether it was possible to obtain the passage of adequate laws to protect the cultivator of the oyster in his rights to the bottoms which he leased.

The first of these problems was solved before taking up the second, and, as has been indicated above, it has been solved satisfactorily and proved that oyster culture could be carried on profitably over large areas of the waters of eastern North Carolina. The Survey then took up the question of adequate legislation for the protection of the oyster culturist, and we believe that we are finally reaching a satisfactory solution of this problem. The Legislature of 1909 passed a law relating to the oyster, a copy of which is given below.

LEGISLATION RELATING TO THE CULTIVATION OF THE OYSTER.

SECTION 1. *Shellfish Commissioner can lease bottoms.*—The Shellfish Commissioner shall have power to lease to any duly qualified person, firm, or corporation, for purposes of oyster culture, any bottom of the waters of the State not a natural oyster bed as defined in this act, in accordance with the provisions of this law.

SEC. 2. *Leasing of bottoms.*—Any citizen of North Carolina or firm or corporation organized under the laws of the State and doing business within its limits shall be granted the privilege of taking up bottoms for purposes of oyster culture, under the provisions of this act, of an area not less than one acre nor more than fifty acres, with the exception of the open waters of Pamlico Sound (and for the purposes of this act open waters of Pamlico Sound shall mean the waters that are outside of two miles of the shore line), in which the minimum limit shall be five acres and the maximum shall be two hundred acres: *Provided*, that the limit of entry in Core Sound, North River, Newport River, Bogue Sound, and all bays and creeks bordering on these

waters, and in Jones Bay, Rose Bay, Abels Bay, Swan Quarter Bay, Middle Bay, Bay River, Deep Bay, Juniper, West and East Bluff bays, Wysocking Bay, Fire Creek, Stumpy Point Bay, Mouse Harbor Bay, Maw Bay, and Broad Creek tributaries of Pamlico Sound, shall be one acre as a minimum and ten acres as a maximum: *Provided further*, however, that at the end of one year from the passage of this act that the minimum area in Core Sound, North River, Newport River, Bogue Sound, and all bays and creeks bordering on these waters, and in Jones Bay, Rose Bay, Abels Bay, Swan Quarter Bay, Middle Bay, Bay River, Deep Bay, Juniper Bay, West and East Bluff bays, Wysocking Bay, Fire Creek, Stumpy Point, Mouse Harbor Bay, and Maw Bay, and Broad Creek tributaries of Pamlico Sound, shall be one acre and the maximum fifty acres; but no person, firm, corporation, or association shall severally or collectively hold any interest in any lease or leases aggregating an area of greater than fifty acres, except in the open waters of Pamlico Sound, where the aggregate area shall be two hundred acres.

SEC. 3. *Lease, how obtained.*—Such persons, firms, or corporations desiring to avail themselves of the privileges of this act shall make written application on a form to be prepared by the Shellfish Commissioner, setting forth the name and address of the applicant, describing as definitely as may be the location and extent of the bottom for which application is made, and requesting the survey of and leasing to the applicant of said bottom. As soon as possible after the application is received the Shellfish Commissioner shall cause to be made a survey and map of said bottom at the expense of the applicant. The Shellfish Commissioner shall also thoroughly examine said bottoms by sounding and by dragging thereover a chain to detect the presence of natural oysters. Should any natural oysters be found, the commissioner shall cause examination to be made to ascertain the area and density of oysters on said bottom or bed to determine whether the same is a natural bed under the definition contained in this act. He shall be assisted in this examination on tonging ground by an expert tonger to be appointed by the board of county commissioners of the county in which said bottom or the greater portion thereof is located, and the question as to whether the oyster growth is sufficiently dense to fall within the definition of the natural bed shall be determined by the quantity of oysters which the said expert tonger may be able to take in a specified time; and on dredging ground the commissioner shall be assisted by an expert dredger, appointed by the board of county commissioners of the county in which said bottom or the greater portion thereof is located, and the question as to whether the oyster growth is sufficiently dense to fall within the definition of the natural bed shall be determined by the quantity of oysters which the said expert dredger may be able to take in a specified time. The Shellfish Commissioner shall require the bodies of bottoms applied for to be as compact as possible, taking into consideration the shape of the body of water and the consistency of the bottom. No application shall be entertained nor lease granted for a piece of bottom within two hundred yards of a known natural bottom, bed, or reef. A deposit of ten dollars will be required of each applicant at the time of making his application, said sum to be credited to the cost of the survey of the bottom applied for.

SEC. 4. *Marking and staking of leased bottoms.*—Immediately upon the completion of the survey and the mapping thereof and the payment by the applicant of the cost of said survey and map, the Shellfish Commissioner shall

execute to the applicant, upon a form approved by the Attorney-General of the State, a lease for the bottoms applied for. A copy of the lease, map of the survey, and a description of the bottom, defining its position, shall be filed in the office of the Shellfish Commissioner. After the execution of said lease, the lessee shall have the sole right and use of said bottoms, and all shells, oysters, and culch thereon, or placed thereon, shall be his exclusive property so long as he complies with the provisions of this law. The lessee shall stake off and mark the bottoms leased in the manner prescribed by the Shellfish Commissioner, and failure so to do within a period of thirty days of an order so to do issued by the commissioner shall subject said lessee to a fine of five dollars per acre for each sixty days default in compliance with said order. The corner stakes, at least, of each lease shall be marked with signs plainly displaying the number of the lease and the name of the lessee. The lessee shall within two years of the commencement of his lease have planted upon his holdings a quantity of shells equal to an average of fifty bushels of seed oysters or shells per acre of holdings, and within four years from the commencement of his lease a quantity of oysters or shells equal to an average of not less than one hundred and twenty-five bushels per acre. The Oyster Commissioner shall, upon granting any lease, publish a notice of the granting of same in a newspaper of general circulation in the county wherein the bottom leased is located.

SEC. 5. *Term of lease, rental.*—All leases made under the provisions of this act shall begin upon the issuance of the lease and shall expire on the first day of April of the twentieth year thereafter. The rental shall be at the rate of one dollar per acre per year for the first ten years and two dollars per acre per year for the next ten years of the lease, payable annually in advance on the first day of April of each year: *Provided*, that in the open waters of Pamlico Sound—and for the purposes of this act the open waters of Pamlico Sound shall mean the waters that are outside the two miles of the shore line—the rental shall be at the rate of fifty cents per acre per year for the first three years; one dollar per acre per year for the next seven years; and two dollars per acre per year for the next ten years of the lease. This rental shall be in lieu of all other taxes and imposts whatever and shall be considered as all and the only taxation which can be imposed by the State, counties, municipalities, or other subordinate political bodies. The rental for the first year shall be paid in advance to an amount proportional to the unexpired part of the year to the first of April next succeeding.

SEC. 6. *Transfer of lease, inheritance of lease.*—The said lease shall be heritable and transferable, in whole or in part, provided the qualifications of the heirs and transferees are such as are described by this act. Nonresidents acquiring by inheritance or process sale, or persons already holding the maximum area permitted by this act, shall within a period of twelve months from time of acquisition dispose of said prohibited or excess of holding to some qualified person, firm, or corporation, under penalty of forfeiture. The lease shall be subject to mortgage, pledge, seizure for debt, and the same other transactions as are other property rights in North Carolina. No transfer shall be of effect, unless of court record, until entered on the books of the Shellfish Commissioner.

SEC. 7. *Releasing of bottoms.*—The term of each lease granted under the provisions of this act shall be for a period of twenty years from the first

day of April preceding the date of granting of said lease. At the expiration of the first lease the lessee, upon making written application on the prescribed form, shall be entitled to successive leases on the same terms as applied to the last ten years of the first lease, for a period not exceeding ten years each.

SEC. 8. *Forfeiture of lease.*—The failure to pay the rental of bottoms leased for each year in advance on or before the first day of April or within thirty days thereafter shall *ipso facto* cancel said lease and shall forfeit to the State the said leased bottoms and all oysters thereon, and upon said forfeiture the Shellfish Commissioner is hereby authorized to lease the said bottoms to any qualified applicant therefor: *Provided*, that no forfeiture shall be valid, however, under the provisions of this section unless there shall have been mailed by the Shellfish Commissioner to the last address of the lessee upon the books of the commissioner a thirty days notice of the maturity of said rental.

SEC. 9. *Title secure.*—If any person within four months of the publication of the notice of granting of any lease makes claim that a natural oyster bottom, bed, or reef exists within the boundaries of said lease, he shall under oath state his claim and request the Shellfish Commissioner to cancel said lease: *Provided, however*, that each such claim and petition shall be accompanied by a deposit of twenty-five dollars. No petition unaccompanied by said deposit shall be considered by the commissioner. The Shellfish Commissioner shall in person examine into said claim, and if the decision should be against the claimant, the deposit of twenty-five dollars shall be forfeited to the State and deposited to the credit of the Shellfish Commission fund. Should, however, the claim be sustained and a natural bed be found within the boundary of the lease, the said natural bed shall be surveyed and marked with stakes or buoys at the expense of the lessee, and the said natural bed be thrown open to the public fishery. If no such claim be presented within a period of four months, or if when so presented it fail of substantiation as provided, the lessee shall thereafter be secure from attack on such account and his lease shall be incontestable so long as he complies with the other provisions of this act. In each and every such case the decision of the Shellfish Commissioner shall be subject to review and appeal before a judge of the Superior Court, who shall render a decision without the aid of a jury, and his decision shall be final.

While this law is not sufficient to begin the building up of an Oyster Cultivation Industry in North Carolina, yet we believe it is a start in the right direction; and, with the passage of favorable legislation at the Legislature of 1913, it is believed that oyster culture will begin on a considerable scale in this State. The old laws relating to the obtaining of grants to bottoms of Pamlico and Core sounds for the cultivation of the oyster were not repealed; so that at the present time we have three methods for taking up bottoms for oyster culture.

A certain amount of educational work has been attempted amongst the oystermen, to show them that an increase in the oyster industry in North Carolina and even its perpetuation is absolutely dependent upon oyster cultivation; that it will mean the renewal of many of the almost

depleted natural rocks, and that it will create a better market for all North Carolina oysters, and thus put the industry on a firm basis. At the present time the catch of oysters in North Carolina has been decreasing very rapidly, as shown by the following table of the catch of oysters for the past ten years:

No. of bushels taken in 1887.....	100,000 (ctr.)
No. of bushels taken in 1890.....	2,700,000 (estimated)
No. of bushels taken in 1893-94.....	60,000
No. of bushels taken in 1896-97.....	40,000

This decline followed the exclusion of Maryland, Virginia, Delaware, and New Jersey vessels that made the large part of the catch of 1890.

No. of bushels taken in 1897.....	858,816	} From the territory under the jurisdiction of the State Oyster Commission.
No. of bushels taken in 1898-99.....	2,450,000	
No. of bushels taken in 1899-00.....	1,900,000	
No. of bushels taken in 1901-02.....	693,516	
No. of bushels taken in 1902-03.....	658,769	
No. of bushels taken in 1903-04.....	505,141	
No. of bushels taken in 1904-05.....	459,485	}
No. of bushels taken in 1905-06.....	291,846	

As is noted from the above table, the catch of oysters in 1890 was 2,700,000 bushels, and was due to the oyster vessels from Maryland, Virginia, Delaware, and New Jersey, that came down into North Carolina waters for oysters, not only buying, but also dredging. This caused a large falling off in the catch of oysters for the next few years; but in '97 it again began to increase—due partly to a demand for North Carolina oysters from packers in Virginia—and a great many North Carolina oysters were shipped to Virginia and Maryland, for packing and also for planting. They were all sold, however, as Chesapeake oysters. From 1898 to the present time there has been a steady decline in the catch of oysters, and during the past year it was under 300,000 bushels.

When we stop to consider that Pamlico Sound is as large as Long Island Sound, where over 80,000 acres are under cultivation, and something like half as large as Chesapeake Bay, where oyster cultivation has only recently been started—there are over 13,000 acres of bottom held for cultivation in the State of Virginia alone—it is seen that the possibilities of oyster culture in this State are very large.

It is of interest to note that the oyster beds referred to above as having been planted by Drs. Grave and Coker were visited in March, 1910, after a lapse of three years. It was not possible to definitely locate all the beds, but some of those in Newport River and Chain Shot Shoal, Harbor Island, and Pain's Bay were located, and oysters taken off of

the beds and examined. It was found that these beds had been pretty thoroughly tonged by the oystermen of the vicinity, which shows that the plants had continued to grow and become apparently permanent rocks. Many of the beds had been regularly worked by the oystermen for the past three years. The oysters were of good shape and quality, and from some of the beds would make good shell stock.

The income that the State may derive from its leased oyster bottoms is problematic, but the industry can be largely increased and put on a self-supporting basis. Rhode Island received in 1909 something over \$105,000 rental from its oyster ground, and Virginia about \$50,000. North Carolina's area of oyster ground suitable for the cultivation of the oyster is large and the State should receive a large amount for the lease of these grounds.

As a final comparison of the oyster industry in four of the Southern States, the following statistics are given of the catch of oysters in Maryland, Virginia, North Carolina, and Louisiana during the season 1910-1911:

State.	Catch of Oysters, 1910-11.	
	<i>Bushels.</i>	<i>Value.</i>
Maryland	3,500,000	\$.....
Virginia		3,500,000
North Carolina	121,219	24,243
Louisiana	1,966,677	1,311,118

PUBLICATIONS
OF THE
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*
11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 6 cents.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade Trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909, 8°, 428 pp. *Postage 25 cents.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. Water-powers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*
21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
22. A Report on the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp., 22 pl., 5 figs. *Postage 15 cents.*

ECONOMIC PAPERS.

1. The Maple-sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a List of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virginina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestone; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina. Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.

15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and Its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

19. Forest Fires in North Carolina During 1909, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pl. *Postage 5 cents.*

20. Wood-using Industries of North Carolina, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Postage 7 cents.*

21. Proceedings of the Third Annual Drainage Convention, held under Auspices of the North Carolina Drainage Association; and the North Carolina Drainage Law (codified). Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp., 3 pl. *Postage 5 cents.*

22. Forest Fires in North Carolina During 1910, by J. S. Holmes, Forester, 1911.

23. Mining Industry in North Carolina During 1908, '09, and '10, by Joseph Hyde Pratt and Miss H. M. Berry, 1911.

24. Fishing Industry of North Carolina, by Joseph Hyde Pratt, Ph.D., 1911. 8°, 44 pp.

VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 50 cents.*

Vol. III. The Physiography and Geology of the Coastal Plain Region of North Carolina. *In Press.*

BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Gives special report on an Examination of the Sand-banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report, and contains Agreements for Co-operation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract; Buncombe County, Transylvania County State Farm, certain Watersheds, Reforestation of Cut-over and Abandoned Farm Lands, on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county-seats in North Carolina; list of Magnetic Declination at the county-seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a letter should accompany sample and stamp should be enclosed for reply.

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of postage needed, as indicated above, for mailing the bulletins desired, to the *State Geologist, Chapel Hill, N. C.*

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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

ECONOMIC PAPER No. 25

PROCEEDINGS

OF

SECOND ANNUAL CONVENTION

OF THE

NORTH CAROLINA FORESTRY ASSOCIATION

HELD AT

RALEIGH, NORTH CAROLINA

February 21, 1912

COMPILED BY

J. S. HOLMES, Forester

**FOREST FIRES IN NORTH CAROLINA
DURING 1911**

By J. S. HOLMES

SUGGESTED FORESTRY LEGISLATION



**RALEIGH
EDWARDS & BROUGHTON PRINTING CO.
1912**

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LETTER OF TRANSMITTAL

CHAPEL HILL, N. C., May 1, 1912.

*To His Excellency, HON. W. W. KITCHIN,
Governor of North Carolina.*

SIR:—A great gain has been made during the past year in forestry work in North Carolina by the organization of the North Carolina Forestry Association. As the North Carolina Geological and Economic Survey was instrumental in organizing this Association and as the Association is working in very close coöperation with the Survey, the proceedings of the Association are in part the record of forestry work of the Survey. For this reason I recommend that the proceedings of the annual convention of the North Carolina Forestry Association, which was held at Raleigh, February 21, 1912, be published as Economic Paper No. 25 of the publications of the North Carolina Geological and Economic Survey. I am including in this same Economic Paper a report on the Forest Fires in North Carolina During 1911, and also some Suggested Forestry Legislation for North Carolina.

Yours respectfully,

JOSEPH HYDE PRATT,
State Geologist.

CONTENTS

	PAGE
Proceedings of the Convention.....	5
Morning Session	5
Address of Welcome, by Gov. W. W. KITCHIN.....	5
President's Annual Address: What Can We Do to Prevent Forest Waste? by DR. D. H. HILL.....	6
Secretary's Report, by J. S. HOLMES.....	9
The Chestnut Bark Disease Which Threatens North Carolina, by J. S. HOLMES.....	13
The Southern Pine Beetle and Its Control, by E. B. MASON.....	15
Enforcing the Present Forest Fire Laws, by JAMES R. YOUNG....	18
Forestry Work of the North Carolina Geological and Economic Survey, by JOSEPH HYDE PRATT.....	22
Appointment of Committees	25
Afternoon Session	26
Coöperative Fire Protection Under the Weeks Law, by J. G. PETERS, U. S. Forest Service.....	27
Forest Protection as Applied to Maryland Under the Weeks Law, by F. W. BESLEY.....	32
The Stock Law and Forest Protection, by HUGH MACRAE.....	34
Report of Committee on Resolutions.....	38
Report of Committee on Nominations.....	41
Constitution of the North Carolina Forestry Association.....	41
Evening Session	44
General Principles of Forestry, by J. G. PETERS.....	44
Extracts from Letters Relating to Forestry.....	46
Forest Fires in North Carolina During 1911, by J. S. HOLMES, Forester...	51
Introduction	51
The Weather	51
Tabular Statement	52
Causes of Forest Fires.....	59
Suggested Forestry Legislation for North Carolina.....	61
Present Laws Relating to Forestry.....	61
Suggested Legislation Relating to Forestry.....	62
List of Publications	67

PROCEEDINGS OF THE SECOND ANNUAL CONVENTION
OF THE
North Carolina Forestry Association

HELD IN
Raleigh, N. C., Wednesday, February 21, 1912

PROCEEDINGS OF THE CONVENTION

MORNING SESSION.

The Convention was called to order in the Hall of the House of Representatives at 10:45 a. m., by the President, Dr. D. H. Hill. After the opening prayer, which was offered by the Reverend A. D. Wilcox, of the Central Methodist Church, President Hill introduced Governor W. W. Kitchin, who welcomed the delegates and visitors to Raleigh and to the Convention. The Governor's address was in part as follows:

ADDRESS OF WELCOME BY GOVERNOR W. W. KITCHIN.

While not congratulating you on the vast numbers present, I am glad to see so many here, representing such a varied citizenship. The accomplishment of your purpose does not depend on numbers, but on the enthusiasm and interest of those present and upon the literature which will go out from this meeting and this Association, and which will no doubt be read by thousands.

I am very much interested in the question of forest protection, but I realize that it is hard to get many people interested who have small forest holdings. This Association gives the opportunity to all citizens to join in the forestry movement. The net results will be beyond calculation.

If there is any land blessed by nature more than another, it is the Coastal Plain region of North Carolina. People wonder why longleaf pine will not reproduce itself on the cut-over forest lands of this region as the old field pine does. There is just one reason, and that is the hog. Hogs dig down in the loose, sandy soil and devour the succulent roots of the longleaf pine, whereas the roots of the shortleaf pine, being smaller and fibrous, escape destruction. In counties where hogs are kept from the forest you find young longleaf pines, showing that these pines under favorable conditions will reproduce themselves as well as the old field pine. I am not advocating a hog or stock law, as this is a local question for each community to solve. I am not in favor of killing all the hogs, either.

In the mountains of this State, where the forests are chiefly hardwoods, the underbrush and young growth, if allowed to grow up, will prevent floods and washing of the land as effectively as the old uncut forests.

This question of forestry must be brought home to the average man. Large holders are, of course, intensely interested; but the average man of North

Carolina has not the habit of saving; and the owners of the small forests ordinarily do not look far enough into the future to properly preserve their forests.

The forests of Germany and France and other European countries pay handsome incomes to the owners, whether state, municipal, or private, and the same conditions will prevail in this country. A Maine timberland owner told me a short time ago that he was cutting his timber under the direction of a trained forester, that he was cutting a large amount each year, but in spite of this the value of the land was steadily going up and the yield increasing.

I am in hearty sympathy with this work. We must not expect perfect laws all at once, but let us get a start and soon we will have an educated people who will adopt improved forestry methods. The earth was given not to one generation, but to all generations, and no man should think he has a right to destroy all the forests from the land in this generation, and then leave the next without timber, when by proper methods all generations can enjoy profits from the forests. A man has only temporary control of land; when he dies he leaves it to some other one. Because of this temporary ownership, because this land is being held in trust for generations to come, we have no right to destroy its future value and usefulness, whether it is farm land or forest land.

I gladly welcome you, and trust your deliberations will be productive of great good.

The President, Dr. D. H. Hill, made a short reply to the Governor's address of welcome and then delivered his annual address, in which he outlined the objects of the Association and strongly urged a campaign of publicity, both through the local papers of the State and by meetings gotten up by the various officials and members of the Association.

WHAT CAN WE DO TO PREVENT FOREST WASTE?

BY D. H. HILL, PRESIDENT NORTH CAROLINA COLLEGE OF AGRICULTURE AND
MECHANIC ARTS.

Nations, like individuals and like corporations, have three ways of adding to their wealth:

First, by making more saleable products and making them at reduced cost and marketing them to better advantage.

Second, by utilizing hitherto waste products.

Third, by a wise management of the resources with which nature has endowed them.

In our country many forces are at work to increase the national output at lowered cost. Especially is this true of farm products. The agricultural colleges and experiment stations, the national and State departments of agriculture, the farm papers, and farmers' organizations, like the Farmers' Union and Soil Fertility Leagues, are bending every effort to make the soil reward man's industry by a richer return and to reduce both the money and the labor cost. Technical schools, too, are sending forth equipped engineers, industrial clubs are standardizing manufacturing plants, and in many cases

coöperation between owners and employees is lowering the cost of all kinds of wares. Marketing is also being more closely studied than before in our country, and coöperative marketing is succeeding in many localities.

All the batteries of science are being turned against waste in manufacture. The millions of dollars made each year in Germany since their skilled and enterprising chemists turned coal tar waste into dyes for the world is a signal example. The woodworks now find utilization for almost every scrap. Pine stumps are changing into turpentine bottles. Corn stalks serve multifarious purposes, and on every hand there is war waged against loss of by-products.

In the third case, namely, waste in natural products, the crusade is only fairly beginning. Taking men as the highest natural product, there is the war against the waste from preventable diseases like smallpox, consumption, hookworm, yellow fever, cholera, etc. This war, which is both humanitarian and economic, is enlisting more volunteers each year. Then veterinary science is striving for preventives against sick waste in the lower animals. The apparent success of cholera serum, the assured possibility of the eradication of cattle ticks, the tuberculin tests for cattle—these are evidences of practical activity in directions needed. The entomologists and the biologists are moving mightily to prevent sick waste in trees and crops. In mining natural products strides towards saving ores have been made. In the Kimberly diamond mines, for example, waste has been reduced to a negligible quantity. However, in the great question we are considering today, forestry, waste still looms prodigiously.

As all the speakers today want to be heard, not for much speaking, but for brief speaking, I want to present this thought: What can our Association do to prevent forestry waste?

First, we can try to change the American's attitude towards a tree. This is a hard task, but only hard tasks are entertaining. Of course we all recall the attitude of our early settlers toward the tree and remember the reason for that position. To them the trees were a twofold evil. They, in the first place, furnished a lurking place for their enemies—Indians and wild animals—and in the second place they kept the industrious ploughman from making a crop or even a road. Hence a tree, like an ugly woman or a peevish man, had few friends. The slogan of these settlers was, not "Swat the fly"; it was, "Swat the tree." Then as population increased, lumber of course became valuable and there was new reason for swatting the tree. Unfortunately, therefore, our attitude towards the tree became fixed and we are still swatting alike the giant oak and the pickaninny pine sapling.

We must needs try to unfix this attitude and create a new slogan, "Save the tree." Save it, first, for its economic value; save it, second, for its salutary influence in conserving rainfall, and preventing erosion; save it, third, for its perennial beauty. We can aid in teaching in our homes, in our schools, in our colleges that our forests are too imperial a resource to be ruthlessly squandered. We can help in raising up wardens to protect them and foresters to reproduce them.

Second, we can aid in the passage of a national law to prevent the importation of insect-infested and diseased plants. We have the unenviable status of being the only great nation that has no quarantine regulations against the importation of diseased plants. So careless are we in respect to diseased

plant stock that France, Germany, Switzerland, Holland, Austria-Hungary, and Turkey absolutely prohibit the entry into their borders of American nursery stock. If we may believe the United States Bureau of Entomology, "A properly enforced quarantine inspection law in the past would have excluded many, if not most, of the foreign insect enemies which are now levying an enormous annual tax on the products of the farms and orchards and forests of our country." According to Marlatt fully fifty per cent of the important injurious pests in this country are of foreign origin and have been imported into the United States through what it would be hardly too strong to condemn as indifferent stupidity. Among these pests are the codling moth, so destructive to our apple trees, the Hessian fly, the asparagus beetle, the hop plant louse, the cabbage worm, the wheat plant louse, the croton bug, the Angoumois grain moth, the horn fly of cattle, the boll weevil, the San José scale, the gypsy and brown tail moths that are destroying New England's forests, the Argentine ant in New Orleans, and the alfalfa leaf weevil in Utah.

Failure to prevent the importation of these pests costs almost untold sums in trying to control the diseases occasioned by them. It is estimated, again using the reports of the Bureau of Entomology, that the cost of spraying apple trees to prevent the codling moth is sixteen million dollars a year; the San José scale costs about ten millions a year in prevention alone. The New England States are now appropriating upwards of a million dollars a year to save their trees from the gypsy and brown tail moths.

In the third place, we can help by urging a State law to prevent the wasting of our forests by fire. It is certainly time that fire ceased to be the lazy man's lawn mower, the 'possum hunter's plaything, and the rabbit chaser's method of driving his game. We punish a man who destroys by fire our wealth in houses, barns, hay ricks or cattle, but we deem it a venial matter for a man to destroy our wealth in trees and plants. With absolute impunity a man may carelessly start and leave a fire that will rage for days and do damage almost beyond belief. If our Association could do no other thing than secure an acceptable law to prevent this destruction, it would certainly have justified its existence.

In the fourth place, let us remember that as a people, the newspaper is largely educating us; let us go to the papers. We can start a forest preservation publicity campaign by writing short articles for our local papers or by getting these papers to copy valuable articles from technical journals or bulletins. We must do this persistently and systematically. As soon as people thoroughly understand the waste now going on, understand how easily this could be remedied, understand how easily a forest can be reset to trees, understand what an increment in wealth such resetting would be, these things will all be done. The thing needed now is to get these facts into the minds of tenants, landowners, lumbermen, sawmill men, and all others who deal directly or indirectly with trees. Whenever a forest fire occurs in the neighborhood of one of our members, let that member get an accurate estimate of the loss caused by the fire and publish it in every paper in the county. If the figures are accurate, comment will be unnecessary.

These, then, are some of the things that our infant organization can attempt. If we give time and thought to these ends, we shall accomplish much.

The reading of the minutes of the last meeting was dispensed with, and the Secretary then read his annual report, which follows:

SECRETARY'S REPORT

By J. S. HOLMES, FORESTER, NORTH CAROLINA GEOLOGICAL AND
ECONOMIC SURVEY.

Since the organization of the North Carolina Forestry Association a year ago, much has been done by it to lay a foundation on which can be built a more general and intelligent appreciation of North Carolina's forest wealth and of the necessity for protecting it.

A large amount of correspondence has been carried on in the effort to secure a vice-president in every Senatorial District of the State. This finally resulted in the acceptance of this position by prominent men in thirty-four out of the thirty-nine districts. The other five districts have so far no representatives in our Association, but suitable men will be selected as soon as possible.

A meeting of the Executive Committee was called for September 21st last, the vice-presidents also being invited to attend. At this meeting a constitution, which will be submitted to this meeting for final adoption, was approved. The work of the Association for the winter was discussed, and two or three special lines of work were decided upon. Realizing the value of information in regard to the number of forest fires occurring in the State and the annual damage done by them, it was determined that this Association coöperate with the North Carolina Geological and Economic Survey in the collection of these figures in order if possible to increase their scope and reliability. In conformity with this decision, your Secretary sent out a request to all the vice-presidents, asking them to submit a list of men, one or more from each township in the several counties of their districts, who would be likely to answer questions about the damage done by forest fires during the past year.

Preparing such a list means considerable work, but nine of the vice-presidents submitted lists covering twenty-four counties. Questions were subsequently sent one man in each township on these lists, and the full returns from these counties seem to thoroughly justify this work. I hope that another year a similar list can be had from every district in the State.*

As one of the objects of this Association is to promote the protection of the forests of the State from destructive insects, at the suggestion of the Association, two of its vice-presidents called meetings in their own districts last fall for the purpose of inaugurating a campaign to control the ravages of the Southern pine beetle, which have been so destructive to the second growth pine forests of the southern Piedmont counties. The vice-president of the Twenty-fifth District, Mr. W. S. Lee, called a meeting to be held in Charlotte on November 25th last. This resulted in the organization of the Mecklenburg Pine Beetle Association, which I understand has been doing splendid work during the present winter in the control of this insect. Mr. A. C. Stroup, vice-president of the Thirty-second District, called a meeting for December the 5th in Gastonia, and this meeting organized itself into the Gaston Forestry Association, the primary object of which was to stop the

*The report on Forest Fires in North Carolina during 1911 is published as a second part of this Economic Paper.

ravages of the pine beetle in that county, but the association intends also to support other forestry measures which will be of benefit to the county. Whether these two associations are in direct affiliation with our State Association or not, we will take pride in coöperating with them in every way possible and will look upon them as our own children. I sincerely trust that the representatives from these two counties who may be with us, will give this meeting some idea of this work which is being carried on in them.

Of course, all this work could not have been carried on without the thorough support and coöperation of the North Carolina Geological and Economic Survey. The Survey looks upon this as the work for which it was organized and created by the Legislature, and so is very glad indeed to coöperate with the Forestry Association in every way that it can.

And here let me express the sincere thanks of the Secretary and of the Executive Committee to those vice-presidents who have coöperated so cheerfully and heartily in the duties that have been demanded of them. If the Association had a vice-president in every district who did as much as those who are taking a real interest in the work, the Association could make itself felt in a very short time in every corner of the State, and the object of this meeting, which is to arouse the people to the necessity of electing Representatives in our next General Assembly who will be interested in the matter of forest protection, could be attained.

I do not know whether or not it comes within the scope of a Secretary's report to call the attention of this meeting to certain pressing questions which the Association might take up in the near future, but, with the permission of the President, I am going to briefly outline a few ideas which I hope will be discussed at this meeting and some definite action taken. At the last meeting of the Association the principal topic of discussion was a proposed forestry law which had then been introduced before the General Assembly. This law was considerably changed by the committee appointed by this Association to draft a law, and was subsequently modified so that its passage at the last session of the Legislature might, if possible, be secured. Unfortunately, neither this bill nor any other general forestry bill was passed. The Association should bend every effort the coming year to impress upon the people and upon the candidates for the Legislature the pressing importance of passing some good forestry law during the next session of the Legislature. Our President has just outlined a plan of campaign looking to this end.

Forest Protective Associations furnish a plan for the protection of the forests from fire which can be operated by the owners themselves until the State assumes this duty. Such associations seem to me especially suited to certain areas of our mountain forests. Effective Forest Protective Associations have been organized in some of the Northwestern and Northern States, and Mr. W. B. Greeley, Assistant Forester of the United States, in an address to the Hardwood Manufacturers' Association, recently strongly recommended them as one of the best means of protecting mountain forests. In this connection Mr. Greeley says:

"Aside from action by the State governments, however, coats must be taken off and good gray matter expended in hard work on the protection of the individual timbered property. In this work, the experience of some of the Northern and Western timber owners as to the value of coöperation

should be of real value. One of the hardest problems confronted in protecting the individual tract of timber is the excessive cost per acre when this work is attempted on a small scale by each owner acting independently. In certain of the Northwestern States with which I am familiar, this phase of the question has been very effectively met by the consolidation of interests for the purposes of fire protection. This is done through the organization of timber protective associations which handle the work of fire patrol, construction of telephone lines and other necessary improvements, and the actual fighting of fire, jointly for all their members. Some of these associations, representing from 200,000 to 300,000 acres, headed by an executive committee and chief warden and meeting expenses by a pro rata assessment per acre, have developed the most efficient protection of timberland on a larger scale than any I have seen in any portion of the country, under any organization, public or private. Large areas of coniferous timber in the Northwest, where the character of the forest and the unfailing annual drought make the fire risk far greater than in the hardwood belt, are now being protected efficiently through such agencies at a cost in ordinary seasons of two or three cents an acre. It is my judgment that you will find the solution of your protection problem in this principle of coöperation with your neighbor and the pooling of common interests for this specific purpose."

I would like to call the attention of those who are personally interested in fire protection to the whole of Mr. Greeley's speech, which advocates fire protection as the most practical and most pressing need of timberland owners at the present time. It seems to me to point very clearly to the fact that even private or coöperative fire protection is profitable, and the matter is certainly worthy of careful consideration. If this Association could engineer the organization of such a protective association in western North Carolina, its existence would be amply justified though it did nothing else.

During the last session of the General Assembly, Governor Kitchin sent a special message to the Legislature, calling the attention of the representatives to the second section of the Weeks bill, just then passed by Congress and signed by the President. This section promised any State which should have a definite appropriation and a State system of fire protection, financial aid and assistance up to the amount of money appropriated by such State. It was the hope of the Governor that the North Carolina Legislature would pass such a law as would enable us to take advantage of this coöperative offer of the Federal Government. We have with us today Mr. J. G. Peters, of the United States Forest Service, who is in charge of the coöperative work of the Government under this bill, and he will explain this plan, which is now in operation in six or eight different States. After we have heard Mr. Peters, I think this Association should take some steps to endorse the work of the Government and try to get the State to take steps to secure its share of the appropriation and take advantage of this offer of assistance.

I have already outlined what has been done by the Association in the attempted control of the Southern pine beetle, but I want to add a word as to the future work along these lines. Reports from Cleveland and Union counties indicate that the pine beetle is as destructive in those counties as in Gaston and Mecklenburg, and I trust that local associations may be formed in these counties also for the organization of control work.

The question of forestry education in the colleges and schools of the State

is of very pressing importance, and I think the Association should endeavor to have this phase of education introduced and extended. I understand from our President that elementary forestry is being taught in the College of Agriculture and Mechanic Arts in Raleigh; with this exception, there is, so far as I am aware, no forestry education carried on in the State. The trustees of the State University have, I believe, decided to have some kind of instruction along these lines introduced into that institution as soon as sufficient funds may be provided by the Legislature. The women's clubs have had much influence in starting this phase of education, and I would respectfully suggest that they take up the matter of introducing forestry into the public schools and make it their chief forestry work for the ensuing year. I think the women of the State are probably more interested in the education of the children than they are in the passage of certain laws which the men are working for, and such a division of labor among the members and supporters of this Association might accomplish large results.

There is another way in which the women of the State can assist very materially in the movement to formulate a settled and permanent forest policy for North Carolina, and that is by securing the universal observance of Arbor Day. An Arbor Day was first advocated by the Honorable Sterling Morton over thirty years ago, and his own State of Nebraska was the first to adopt it. Since that time the observance of Arbor Day has become more or less general throughout the country; nevertheless, while Arbor Day exercises have been held sporadically in some of the schools of this State for a number of years, so far the efforts to make this a State custom have failed. Two or three years ago an Arbor Day Bulletin was prepared, to be published by the State Board of Education, but neither it nor the State Geological and Economic Survey, which prepared the bulletin, has received enough encouragement from the people of the State to justify them in publishing it. If all the school children of the State could take part once a year in some Arbor Day exercises, they might imbibe a certain knowledge of the value of our trees, both commercial and æsthetic, which would lead them to further study of the question and train them to look upon the forests as something to value and conserve, rather than to abuse and destroy, as, unfortunately, their fathers had been taught to regard them. I have no doubt that the women's clubs in the different towns could induce at least a local observance of Arbor Day, as they are doing this year in my own town, and, in so doing they would very soon pave the way for State observance of this day.

My final suggestion for work for the Association is concerned with a new and very pressing duty which devolves upon all North Carolinians who are in any way interested in the forests of the State, namely, the laying of thorough plans for immediate and vigorous attack upon the chestnut bark disease as soon as it invades this State. I had invited Dr. Haven Metcalf, the Chief Pathologist of the United States Bureau of Plant Industry, to attend this meeting and lay the matter before you. But, owing to a previous and more important engagement for all members of his staff engaged in this work, neither he nor any of his assistants were able to attend, so that I am going to take it upon myself to outline in a short paper the nature of this menace and suggest action that may be taken by this Association to provide against it. Suffice it to say here that when the time comes, prompt and effective action must be taken, and this Association should lay its plans so that it will know exactly what to do and how to do it.

And now, to recapitulate briefly: What are the forestry questions most prominent at this time which the Association can assist in solving?

(1) The question of fire protection is uppermost in the minds of most of us, and we should make a special effort the coming summer to bring this to the attention of the voters, and especially to the attention of the prospective candidates for the Legislature, with the hope of getting an Assembly favorable to forestry legislation.

(2) This must be done, and some kind of legislation passed before the second question can be taken up, which is, the coöperation of the State with the Federal Government in fire protection on the headwaters of streams, as will be explained by Mr. Peters.

(3) Wherever the pine is being destroyed by the pine beetle, the Association should make a special effort to found local associations in the counties affected, and then coöperate with them in every way possible.

(4) The Association should encourage and advocate the teaching of forestry in the colleges and public schools of the State, and should endeavor to make the observance of Arbor Day universal.

(5) The Association should take up in earnest the question of the chestnut bark disease, and bend every effort to keep it out of the State and then, should it get into the State, to combat its spread.

Finally, all these measures could be pushed forward most successfully if we had the coöperation of the State Legislature, so that small State appropriations might be made for the purposes of controlling forest fires, of coöperating with the United States in fire prevention, of coöperating with counties in the fight against the pine bark beetle, and of coöperating with the United States in the protection of our forests from the chestnut blight disease.

Motion was made and passed that the Secretary's report stand approved.

Mr. Holmes then read a paper on "The Chestnut Bark Disease."

THE CHESTNUT BARK DISEASE WHICH THREATENS NORTH CAROLINA.

BY J. S. HOLMES, FORESTER, NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

Just four years ago Mr. Haven Metcalf, of the United States Bureau of Plant Industry, in a brief circular* wrote, "The bark disease of the chestnut caused by the fungus *Diaporthe parasitica* (Murrill), has spread rapidly from Long Island, where it was first observed, and is now reported from Connecticut, Massachusetts, Vermont, New York as far north as Poughkeepsie, New Jersey, Pennsylvania, and possibly Delaware. It is no exaggeration to say that it is at present the most threatening forest tree disease in America. Unless something now unforeseen occurs to check its spread, the complete destruction of the chestnut orchards and forests of the country, or at least of the Atlantic States, is only a question of a few years' time."

Since that time two or three circulars have been issued on the subject by the United States Bureau of Plant Industry as well as numerous articles and

*"The Immunity of the Japanese Chestnut to the Bark Disease," by Haven Metcalf, Bul. 121, Pt. vi., Bureau of Plant Industry.

bulletins by the different States. This disease has now spread into Virginia and West Virginia, and seriously threatens the forests of this State. Mr. Metcalf writes, in answer to my letter asking him to be present at this meeting:

"I regret very much that it is impossible for me to come myself, or send you a man for the meeting of your Association, as it seems necessary to have every one at Harrisburg who has any knowledge of the disease. I regret very much being unable to be present myself, as there is a good deal to be said on the subject of the chestnut bark disease, and I have little doubt that it will reach North Carolina by another year."

The meeting at Harrisburg to which Mr. Metcalf refers, has been called by the Governor of Pennsylvania to consider ways and means for combating this disease, which has now spread over the larger part of that State. Invitations were sent out to interested people all over the Atlantic States, and three of the men whom I had hoped to have at this meeting have had to decline on account of attending the meeting at Harrisburg yesterday and today.

At a recent meeting of the foresters from the Eastern States in New York, at which the writer and many prominent railroad men were present, the whole time of the meeting was taken up with a discussion of ways and means to dispose of the enormous amount of dead chestnut in the southern New England and North Atlantic States which has been killed by this disease.

Not only were reduced rates on the railroads advocated for dead chestnut wood, so that immediate cutting of the infected timber could proceed without serious loss, but the erection of new plants for the utilization of this dead chestnut wood through the most seriously affected regions of New England, New York, and Pennsylvania was strongly urged.

Last year the State of Pennsylvania appropriated \$275,000 "for the investigation and scientific study of this problem, and, more specifically, to ascertain the exact extent of the blight, and to devise ways and means through which it might, if possible, be stamped out."

The Pennsylvania Chestnut Blight Commission, which has been appointed to carry out these provisions, is carefully studying the disease and at the same time taking strenuous measures to prevent its further spread. They are asking neighboring States who are threatened with this pest to coöperate with them in every way possible.

The chestnut timber of North Carolina means more to the farmers, the timberland owners, and the manufacturers of the western part of the State than any other tree. According to an estimate made by the North Carolina Geological and Economic Survey in coöperation with the United States Forest Service, there are slightly over three million acres of forest land in North Carolina now growing a larger or smaller proportion of chestnut timber. On this area, mixed with many other species, there was a stand in 1909-'10 of approximately 3,380 million feet board measure of chestnut timber. In addition to this there was at least one and one-half million cords of chestnut cordwood that could not be converted into lumber. Putting the low stumpage value of one dollar per thousand or fifty cents per cord on this timber, we have a present value for the chestnut timber in North Carolina of at least four million dollars.

The cutting, marketing and manufacturing of this timber will mean at least forty million dollars to the citizens of this State, and there can be no

doubt but that an annual income of at least one million dollars could be permanently secured from the chestnut timber alone, were these mountain forests managed in a conservative way. Chestnut is the tree best adapted to all situations in our mountains, and is the tree that comes soonest to financial maturity, while its use for lumber, for telephone poles, for tanning extract, and for pulp, makes it the most widely useful tree commercially of any in that region.

Can we afford to lose this important source of revenue without a struggle? We certainly can not.

Every member of this Association can do something towards delaying or preventing the invasion of this State by the chestnut bark disease by writing to his Congressman to support the bill now before Congress, which calls for an appropriation of \$80,000 for the use of the United States Department of Agriculture, to be used in a thorough study and investigation of this tree disease, with the view of devising ways and means to combat its further spread. If this bill is passed, the department would undoubtedly send experts into North Carolina the coming summer to watch out for this disease and to plan a campaign to prevent its invasion or its further spread, should it appear in this State. I think also that this Association, as a body, should go on record as approving this bill.

Every person who goes into the woods where chestnut grows, should make a point of looking out for this disease and reporting it to the Government as soon as it is discovered, that immediate steps may be taken to combat it.

In order that I need not take up valuable time with a description of the appearance of this disease, I have brought a sterilized sample, which was sent me by the Bureau of Plant Industry, which all who are interested can examine. Anyone who has once seen it will have no difficulty in recognizing this disease.

For detailed description and suggested methods of control, I would refer you to Farmers Bulletin 467, issued by the United States Department of Agriculture, and to the report on the Harrisburg Chestnut Bark Disease Conference which will no doubt be published without delay by the Chestnut Blight Commission of Pennsylvania.

Mr. E. B. Mason, an expert in the office of Forest Insect Investigations of the United States Bureau of Entomology, who the past year was in charge of the Spartanburg (S. C.) Field Station of that office, which was charged with conducting a campaign for the control of the Southern Pine Beetle through the South Atlantic States, was then introduced. Mr. Mason's address was as follows:

THE SOUTHERN PINE BEETLE AND ITS CONTROL.

By E. B. MASON, UNITED STATES BUREAU OF ENTOMOLOGY.

GENTLEMEN:—It is a great pleasure for me to be present at this meeting for three excellent reasons:

First, because the first State recognition of our efforts to show the people of the South how to save their pine from the attacks of the Southern pine beetle was from North Carolina.

Second, because to the coöperation of the North Carolina Forestry Association, with those interested, was due the formation of the Mecklenburg Pine Beetle Association and the Gaston Forestry Association, which were followed by the formation of similar organizations in other Southern States.

Third, because these two associations formed for fighting the beetle are not merely names, but have actually performed the work for which they were organized.

I look forward with confidence to a time within the near future when we can say that the people of North Carolina have established systematic insect control for the benefit of every pine timber owner in the State.

I do not think it necessary for me to dwell on the seriousness of the situation in regard to the Southern pine beetle. There is not a man here who has not seen the appalling amount of dead pine. This dead pine is gone. We can not bring it to life again, but we can, and I am sure we will, try to stop the dying of further large quantities of timber. Since it is possible for us to make efforts in this direction, it seems to me that we should look on further loss from this cause as absolutely unnecessary, and hold no one but ourselves to blame for it.

The Southern pine beetle has existed, to our knowledge, in the South for over forty years. It is only at long intervals, however, that it increases to such numbers as to cause widespread depredations such as the great invasion of 1890-'93, which destroyed a large percentage of the pine in the Virginias and was only stopped by unusual climatic conditions. The warning sign of a depredation is the increase in number and size of the groups of dying pine. This warning has been only too plainly manifest the last two years. We have no reason to anticipate that any natural factor will come to our aid. We should be more than foolish if we based our hopes of relief on any such intervention of Providence. In other words, gentlemen, it is distinctly and plainly up to us.

In order that you may understand the reasons for the methods of control we advise, I am going to run through the life history of this beetle, beginning with the early summer, as outlined by Dr. A. D. Hopkins, who is the authority on forest insects of the Department of Agriculture, Bureau of Entomology.

The beetles attack and leave a tree in about thirty days or even more quickly. Three or four generations in the North and four or five in the South develop during the season. In other words, they may be increased thousands of times from their original numbers during the year. They fly during the night, and sometimes in the day, and alight on the upper trunk of a living pine. (Observation has shown that they seldom go as far down as the first eight or ten feet of the butt cut, depending, of course, on the size of the tree.) When they alight on a tree they bore through the bark to the wood, but they do not bore into the wood. In the inner bark and marked on the surface of the wood they make those winding galleries with which you are all familiar. These galleries, crossing and recrossing, girdle the tree many times, thus killing it. The eggs are laid along these galleries, hatch into little grubs, which feed for a short time on the inner bark, and then go into the outer bark where they change into beetles with wings. The beetles bore out of the bark to the light, fly away and attack other trees. They can fly for three or four miles or more, may go in any direction, and, therefore, are a direct menace to all pine within three or four miles of a center of infestation.

Since they kill and leave a tree in thirty days or even more quickly, you will never find their broods in old dead trees or trees from which the foliage has fallen. You will find many other kinds of beetles in old dead trees, but never this one. You will find this beetle in trees on which the foliage has begun to fade to light green or has faded to yellow or greenish brown. In fact, after November 1st, any dying or dead trees which retain their foliage are apt to harbor the hibernating beetles, and in addition they are also found in trees on which the foliage is green but which have pitch tubes on the trunk—these trees fade later.

After November the beetles remain in the trees and instead of coming out in thirty days they don't come out till spring. You have them trapped. That is the time to go after them. It is only necessary to cut down the trees containing the beetles and destroy the bark in which the broods are spending the winter. You do not have to destroy the wood, you do not even have to destroy the tops and laps. Bear in mind that the beetles have left the old dead trees from which the foliage has fallen. The old dead trees may be totally disregarded in control operations.

About destroying the bark in which the broods of the beetle are wintering, it can be destroyed in several ways and in most cases in such a manner as not to involve a direct expense. The tree in which the beetles are spending the winter may be turned into cordwood. This cordwood should be burned, however, and care should be taken to gather up the bark that falls in cutting between November 1st and May 1st. These same kinds of trees may be turned into timber, but the slabs with the bark on must be burned between November 1st and May 1st. There are other methods, but these are the principal ones. In all methods the underlying principle is the same—the destruction of the bark in which the broods of the beetle are wintering.

You notice I have confined control operations to the winter. There is an excellent reason for this. The cutting of any dead or living pine during the summer months in a beetle infested country will attract the beetles from three or four miles. They will go to some extent into the fresh felled green timber, but the greater part of the attack will be against the surrounding healthy timber. It is therefore a very dangerous thing to cut pine during the summer unless every one in the neighborhood cuts their dying infested trees at the same time and destroys the bark. Of course, when the beetle is under control there should be no reason for not cutting timber at any season of the year.

I want to speak briefly on two popular errors. Some people will tell you that the dying of the pine during the last summer was due to the drought. Trees have been dying every month in the year in moist as well as dry localities, in wet weather as well as in dry weather. Drought is, therefore, out of the question. Many people will tell you that the death of the pine is due to the sawyer or borer. This is a natural mistake, because of the size of the sawyer and the noise which it makes when at work. It is, nevertheless, a mistake. It has long since been determined that this class of borer never attacks a living, uninjured pine. It comes in while the beetle is working or after the beetle has left the tree.

We can divide the problems to be met into two divisions: The woodlot proposition and the lumbering proposition. In the woodlot proposition the owner uses his woodlot for his fuel supply. He can just as well use his in-

feasted trees for cordwood and thus control the beetle at no expense. On large holdings where cutting is going on the desired result can be obtained by burning the slabs from the infected trees with the bark on. Where the timber is to be held and there is no market for cordwood, control measures must be conducted at direct expense. The question to determine is whether the amount expended will be justified by the timber saved. Disregarding the increase in the danger of fire from the dead timber and the very great possibility of an increase in the number of trees killed each year, I want to say distinctly to you that it *will* pay. The trouble with the large holders is that they do not know how much timber they are losing.

No lumberman who is suffering from inroads by the beetle, after he has made an investigation into how much timber he is losing, will hesitate for a moment in starting control operations. He will not hesitate any more than he would hesitate to go out and fight a forest fire—indeed, an attack by insects differs only from a forest fire in that you have more time to fight it, and I quote your forester, Mr. Holmes, as saying that more timber has been killed in the southern Piedmont section of North Carolina by the Southern pine beetle than has been killed by fire.

Gentlemen, the proposition is up to every individual timber owner. Dr. Howard, Chief of the Bureau of Entomology, has put the resources of the Bureau at your service. We can only give advice, however. You must do the actual work. If all will help, if all will go at the very simple task before them without waiting for their neighbors to begin, we can control this beetle and save an amount of pine from dying, the value of which I should not dare estimate in dollars.

Gentlemen of the North Carolina Forestry Association, I have endeavored to put this matter before you as simply as possible. If there are any questions unanswered in your minds, do not, in justice to yourselves and to us, let me go away with them unanswered. I think you will agree with me that every man here who controls pine timber should get at this matter at once. It does not admit of delay. Realize that you are engaged in a labor not only for yourself, but for your neighbor, and indeed for the whole South, and let your watchword be, "Do It Now."

A general discussion followed Mr. Mason's speech, in which Mr. Z. W. Whitehead, of Wilmington; Dr. C. H. Herty, of Chapel Hill; Mr. W. S. Pharr, of Charlotte; Mr. G. K. Massengill, of Four Oaks, and several other delegates, took part.

Honorable James R. Young, State Insurance Commissioner, then read a paper on what his department can do to prevent forest fires. This address was as follows:

ENFORCING THE PRESENT FOREST FIRE LAWS.

BY JAMES R. YOUNG, INSURANCE COMMISSIONER.

It is especially gratifying to me to be present at your meeting and by my presence and words endorse and extend aid to the North Carolina Forestry Association in the great work it is undertaking to do in the preservation of our forests. Upon me as a State official devolves the duty of attempting their

preservation by enforcing the law upon our statute books to punish any one responsible for their destruction or injury by fire, and I most heartily welcome the aid of the members of your Association, both collectively and individually. We are justly proud of our great nation; but as a people we are at the same time the most progressive as well as the most careless and wasteful people on earth. There are none equal to us. It is, indeed, a hopeful sign that we are being aroused by the cry of "Conservation." It is encouraging to see many of our best men traveling over this broad land, stirring up and organizing our people to aid in the conservation of America's natural resources. That much has been and more will be accomplished goes without saying, for who is not in one way or another endorsing this great work and aiding in its accomplishment!

FIRE WASTE.

I venture the assertion, and feel that I can make good the statement, that in no field is there a greater need of conservation, or an opportunity of so certainly accomplishing big results as in stopping our fire waste. We can and should hasten the day when we as a nation no longer countenance in our midst the criminals who, by carelessness, indifference, or deliberate incendiarism, are destroying our property and menacing the lives of our men, women, and children. The total fire losses in the United States and Canada during the year 1911 were \$234,337,250, and during the past thirty-five years these losses amount to \$5,181,345,425. These figures do not include the cost of insurance nor the money expended in fire departments.

The fire losses and cost of fire prevention in the United States amount annually to \$450,000,000, or more than the total American production of gold, silver, copper, and petroleum in a year.

Fire losses exceed the total cost of the army and navy of the United States for a year, and are greater than the annual expenditure for pensions, or the annual cost of the United States Postal Service. Fire in the United States costs over five hundred dollars each minute. Every two minutes the value of the average home of our working man goes up in smoke; while every ten or fifteen minutes there is consumed by the flames the value of fine homes such as we point to with pride as ornaments to our cities and towns. As if this were not enough to arouse us, over fifteen hundred people are killed and more than five thousand injured annually by the result of fires.

PREVENTABLE.

This great fire waste is preventable to a large extent, and by the exercise of even ordinary care and foresight over one-half of our fire waste can be prevented. The general per capita fire waste in the United States is \$2.51; in Europe, 33 cents. Cause: The latter has better construction, less carelessness, and increased responsibility. In nothing is the old adage, "An ounce of prevention is worth a pound of cure," so true as in stopping our appalling annual loss by fire. If the buildings in the United States were fireproof, as in Europe, the annual cost of fire losses and protection would be less than \$100,000,000.

The enormity of our fire waste and its effects upon the business and progress of our country is shown by the importance of the business of fire insurance.

The insurance companies engaged in this class of business alone have assets of about \$450,000,000. In 1910, one hundred and seventy-five stock fire companies assumed risks of \$36,357,713,046 for premiums of \$273,557,380, while in North Carolina alone \$257,375,954 were assumed in risks for premiums of \$3,296,096. The fire losses in North Carolina amount annually to practically \$1,500,000, or \$4,000 a day, and yet with proper care two-thirds could be prevented, with a saving to our State in taxable property and to our citizens of \$1,000,000 a year, or over \$2,500 a day. The loss of property is not all, for, as in the rest of the country, there is a great loss of life. During last year I noted in the papers twenty-one persons who lost their lives by fire in this State; while so far this year, with only one and a half months gone, the State papers have recorded already as burned fifteen persons, of whom twelve have died as the result so far.

FOREST FIRES.

In 1910 the loss by forest fires was \$26,000,000, or over ten per cent of the fire waste of the country. If the same per cent holds good in our State, and I see no good reason why it should not, then the annual loss in North Carolina by forest fires amounts to \$150,000. This can hardly be considered a large estimate when you count not only the standing timber and buildings but the destruction of buildings and small growth.

My observation would lead me to believe that by far the larger bulk of this loss was caused by thoughtlessness and carelessness, rather than by maliciousness. This shows the wisdom of our legislators in providing for the punishment of those responsible for fires due to either cause, as set out in Section 3346 of The Revisal of 1905 of North Carolina, as follows:

SECTION 3346. Woods.—If any person shall set fire to any woods, except it be his own property or, in that case, without first giving notice in writing to all persons owning lands adjoining to the woodlands intended to be fired, at least two days before the time of firing such woods, and also taking effectual care to extinguish such fire before it shall reach any vacant or patented lands near to or adjoining the lands so fired, he shall, for every such offense, forfeit and pay to any person who shall sue for the same, fifty dollars, and be liable to any one injured in an action, and shall moreover be guilty of a misdemeanor.

Of course, I have had some forest fires investigated, but so far I have not had the success in ferreting them out and punishing the originators as I have in other fires, where I have obtained five convictions since January 1, 1912, and one hundred and thirty-three since I have been charged with this fire marshal work in this State.

All laws designed to stop fire waste are largely educational, and accomplish much when handled in this way; hence, I have attempted to spread this law over North Carolina in the form of posters, such as you see distributed among you today. These posters are sent out to the sheriff and other officers of our counties, as well as to all lumber companies and others interested in the protection of our forests. The Department will continue to send them in such quantities to any citizen of North Carolina as they will post or distribute.

Of course our attempts to stop forest fires must take into consideration all the different causes for which they are started, and our people must be edu-

cated to realize that the results along the lines desired do not by any means compensate for the possible, or even actual loss by such fires. There are many things that in themselves appear to be small that cause these forest fires. The night hunter, by carelessly handling his torches, or leaving fires in the woods to be fanned into flames and spread by rising winds, often starts a fire that sweeps over the forest and does immense damage. Again, the smoker in passing through the forest, or the hunter by day or night, carelessly throwing aside the stump of a cigar or cigarette, or shaking the ashes from a pipe, starts a fire that spreads over the whole country and does immense damage. A great many of our owners of lands have undertaken to prohibit hunters from passing through their lands, and in this way a considerable prejudice has been raised against landowners, the hunters feeling that the objection is raised purely because of the game that they seek, while as a matter of fact the landowner is more interested in preventing damage to his lands by fires than he is in the game caught upon his land or a few trees cut down by the night hunter. A proper education must be undertaken and carried out to overcome this prejudice.

Again, the farmer in clearing his lands in the spring will build up fires to burn off the brush, and by carelessness or thoughtlessness allow the flames to be carried into adjacent fields or forests by the winds prevalent in the spring, and thus the country around for miles will be swept by fire and a damage done that will amount to more than all the crops that will be raised on the lands being cleared. The farmers need to be educated to the danger of spreading these fires, and the necessity of laws for the prevention of these fires in order to do away with the damage caused by them. Again, the railroads should be required by law to keep their rights of way so protected from the surrounding country that the sparks from their engines will not start these fires, for they not only do a great damage to the country and the owners of the lands, but tend to promote a prejudice between the people and the railroads.

In conclusion, Mr. President and gentlemen, I beg to say that it will afford me great pleasure to do anything I can in enforcing the laws that we now have on our statute books to prevent forest fires, and to aid in having our Legislature to add other suitable and necessary laws, and especially should these laws be so formed and enforced that the people may be educated to realize their advantage and necessity, so as to lessen instead of increasing the friction between the different classes of our people. We have already had some of this in the prejudices brought against lumber companies who have undertaken to protect their holdings by prosecutions against parties for starting fires.

I will unite with you, and use every means in my power in enforcing the laws, and reducing our fire waste from this cause in our State.

An interesting discussion followed Mr. Young's paper, in which Mr. Joseph Hyde Pratt, Mr. J. S. Holmes, and others took part.

Mr. Joseph Hyde Pratt, State Geologist, then gave a talk on the work the North Carolina Geological and Economic Survey was doing to

interest the people in the subject of forest protection. His address was as follows:

FORESTRY WORK OF THE NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

BY JOSEPH HYDE PRATT, STATE GEOLOGIST.

The North Carolina General Assembly of 1905 reorganized the North Carolina Geological Survey, changing its name to the North Carolina Geological and Economic Survey, and in stating the object of the Survey the law says, in part, that the Survey shall make examination of the forest resources of the State and shall make a classification of the forests with special reference to their bearing upon the occupation of the people; and shall study a plan for protection of the forests, with special reference to the preservation of the flow of streams and water powers of the State. This phase of the work of the Geological Survey has become one of its more important problems and studies.

It has been estimated that approximately eleven million acres of land in North Carolina are now supporting some kind of forest growth. Nearly one-half of this area is probably absolute forest land, that is, the land is too rough to cultivate properly; is too easily washed by rain or floods; is too poor to yield adequate returns for the labor put upon it, or, for other reasons, the production of timber crops is the most profitable use to which it can be put, for a great many years to come. This large amount of forest land represents an investment of from twenty-five to fifty million dollars at the least. One-sixth of the entire wealth producing capital of the State is invested in forest lands or in industries directly depending upon the products obtained from the forests. Thus it is seen that the problems relating to forestry are most vital to the industrial life of the State, and the State should put forth every effort to make these forests as nearly perpetual as she possibly can, and encourage and stimulate the owners of these lands to assist her in conserving them.

The Geological and Economic Survey has from its investigations realized most thoroughly the need of conserving and protecting the forest areas of the State, and has for the past two years employed constantly a forester to investigate and assist in carrying out measures that would tend toward awakening the people of North Carolina to a realization that some legislation must be enacted to prevent the total destruction of our forests, and thus one of the most valuable assets of the State.

The forestry work is varied in character and consists of:

1. An investigation of the forest conditions of North Carolina.
2. A study of forest fires in North Carolina.
3. A statistical study of the wood-using industries of North Carolina.
4. The examination of timber areas in regard to practicing scientific forestry.
5. Examination of watersheds belonging to municipalities in regard to their protection from fire and contamination.
6. Investigations regarding the reforestation of abandoned farm lands and cut-over lands.

In order to obtain more accurate knowledge regarding the timber resources of the State, it was decided to make a thorough investigation of the various conditions of the forests, county by county, so that the Geological and Eco-

conomic Survey would be in a position to answer the many questions that were being asked regarding our forestry resources, such as:

What are our forest resources, and how long are they likely to last at the present rate of timber consumption?

Can we insure a permanent supply for our manufacturers, as well as for domestic and other uses?

Is the timberland yielding to its owners and to the State as large returns on the enormous amount of money invested as is possible?

Can the actual yield be increased?

Over fifty counties have thus far been examined and one report has already been published on the timber resources of the counties west of the Blue Ridge. The counties in the western half of the Piedmont section have also been examined and a report has been prepared on this which will be published at an early date.

By far the greatest enemy which the forests of the State have to contend with is fire. The destruction wrought by the annual and periodic fires which burn over many thousand acres of woodland each year involves an enormous loss to the people of the State through the diminished value of their property. No attempt has ever been made to collect statistics regarding the amount of damage to our forests from this source, but it was considered advisable by the Survey to obtain such data so that it could show more forcibly to the people of the State what they were losing each year from the effects of forest fires. Unfortunately, forest fires usually have been taken as a matter of course by our people, and in many cases have scarcely been noticed. Our lumbermen, however, have begun to realize that with the possible exception of land supporting mature pine timber with little or no young growth, ground fires can do and are doing great injury to our timberlands. Our farmers and other landowners are beginning to realize that every time a ground cover of leaves is burned up the land becomes that much poorer. Owners of waterpowers know that with the burning of the woods the rains run off faster, permitting a much smaller amount of water to soak into the soil, so that floods and periods of low water are both more frequent. Cattle-men who have contended that by burning the range they get earlier grass for their stock are now beginning to realize that in doing this they are really killing the goose that lays the golden egg, for by burning they get less and less grass every year. The man who owns forest land and is holding it for increase of growth, both for domestic supply and for sale, has learned that he is losing at least half the yield he ought to get by allowing his woodland to be burned over. Unfortunately, however, it is necessary to instruct the people at large regarding the great loss to the State by forest fires before we can obtain legislation that will give the necessary protection.

A series of studies has been made regarding the forest fires of North Carolina and statistics have been collected for several years regarding the number of fires, their causes, damage done, etc. The results of these investigations have been published as Economic Papers Nos. 19 and 22. The damage done by fires is estimated as over \$400,000 per year during the past three years.

Although there are a number of laws on the statute books of North Carolina relating to forest fires, yet the machinery necessary to carry out these laws has never been passed, and it is absolutely necessary that other laws shall be passed if we are to preserve our forests from fire.

As such a large part of North Carolina's wealth is invested in timberland and wood-using industries, and realizing the growing shortage in the supply of timber suitable for the use of these wood-using industries and the consequent gradual modification in the requirements fixed by these consumers, and recognizing the value both to the producers and consumers of timber of a more intimate knowledge of local market conditions, the State Survey has made a statistical study of the wood-using industries of the State.

This report has been published as Economic Paper No. 20, on Wood-using Industries of North Carolina, and should be of value to the State in assisting her in forming an independent forest policy, and in presenting the advantages the State offers to wood-using industries to locate in it. The timber owner—even the farmer who has a few scattered trees to sell—can learn from this report where a market can be found. The sawmill operator may learn a new use for a wood which he previously considered of little commercial value. The manufacturer will have a source of fairly accurate information concerning a region most likely to supply the lumber he needs. The merchants throughout the country who handle wood products can obtain considerable advantage in buying and selling. There is given in the report the uses of the different kinds of wood that grow in North Carolina and as complete a list as possible of manufacturers who use wood.

Other lines of forestry work taken up by the Survey are the examination of private forest lands for the purpose of recommending improved methods of management and the examination of watersheds from which cities or towns obtain their water supply, in order to recommend the best method of protecting these watersheds from fires and contamination.

The reforestation of cut-over and abandoned farm land is another phase of forestry work that demands considerable attention of the forestry division.

Many hundred thousand acres in all parts of North Carolina now lying either entirely waste or producing scarcely any timber of value can be made to yield their full capacity and make remunerative returns to their owners. The forest lands that have been cut over once or twice can be made to produce other cuttings as valuable as any that have already been removed. In order to secure reproduction it is necessary that seed trees should be left on the cut-over lands to furnish the seed required, or else it will be necessary to set out young trees or sow seed brought in from outside. Then there must be adequate protection for the young growth, and fire and stock must be kept out of the area. Besides these cut-over areas there are many thousands of acres, especially in the middle and western portions of North Carolina, which have been cleared for cultivation and proved unprofitable. Whatever may have been the cause of this, the lands should be reforested. Where lands of this character do not naturally restock in trees, they can profitably be planted in some desirable species. This will not only insure some earning from such land, but it will protect it from washing or deterioration.

Young trees are very susceptible to fire, and many of them, such as the pines, are destroyed in large quantities by stock and hogs, when these are allowed to run at large. Thus, if good results are to be obtained in reforestation, it is absolutely necessary that the planted areas be protected from fire and stock. This is just as true when applied to forests that are reproducing themselves, because the young trees must have a chance to grow, for unless

there is young growth and abundance of it there can be no trees to take the place of the old ones when they are cut.

The chief injury to our forests from cattle, however, is an indirect one, not only in the mountains, but wherever the stock law is not in force. Every year fires are set out and thousands of acres are burnt over in practically every county in which the cattle still run at large, the reason given being that "it improves the range." There is no more widespread or fallacious argument advanced as an excuse for burning the woods than this. And the only basis for it is that the young herbage, having no old growth to cover it, is available for the stock somewhat earlier in the spring if the ground is burnt over in the winter. The total effect of burning the range is very harmful, not only to the woods, but to the range itself. The soils get poorer and poorer year by year by the destruction of all vegetable matter, while the better quality of forage plants are seriously injured or killed out by the fire. The quantity of the poorer kinds of grass which make only early spring pasture, may be slightly increased by killing out the young trees and bushes, but the other forage plants, such as the beggar lice and other peas, on which the stock fatten in the fall, are seriously injured or killed out entirely by fire.

The sooner the whole State comes under the operation of the stock law, the better it will be, not only for the State at large, but more especially for those parts that are now without its advantages. The chief thing lacking to make many parts of North Carolina prosperous agricultural regions is the enforcement of a stock law. Only by putting all the land to its highest use, namely, by cultivating thoroughly and raising as much stock and feed as possible on the cleared land, and by keeping the woodland in the best possible condition by excluding fire and stock, can the present and future prosperity of a community or a State be assured. If it is impossible to bring the whole State under a stock law, there should be a law passed which would make it obligatory on those counties which do not wish a stock law to fence themselves from the counties that adopt the stock law. Thus the counties which wish the open range would be compelled to build a fence entirely around the county, and also be compelled to keep up these fences.

The forestry work that the State Geological and Economic Survey is doing can be very much increased and assisted by the North Carolina Forestry Association, and as State Geologist I can assure this Association of the most hearty coöperation of the Survey in the great work that this Association is undertaking.

Attorney-General T. W. Bickett, who was on the program for an address on the "Forest Fire Laws of North Carolina," explained that owing to insufficient notice having been given him he had been unable to prepare a paper. He, however, showed his interest in the question by attending, and offered his services to the Association in drafting any necessary laws which the Association might recommend. The President then appointed the following committees:

Committee on Resolutions.—Mr. E. B. Wright, Mr. C. P. Heyward, Professor J. F. Webb, Dr. F. P. Venable, Mr. Hugh MacRae.

Committee on Nominations.—Mr. Alston Grimes, Miss Annie F. Petty, Dr. C. H. Herty, Mr. W. S. Pharr, Mr. C. C. Smoot, III.

Auditing Committee.—Mr. D. A. White, Mr. R. R. Cotten, Mr. Z. W. Whitehead.

The Convention then adjourned to meet at three o'clock.

AFTERNOON SESSION.

The afternoon session was called to order by President Hill at 3:10 o'clock, in the Hall of the House of Representatives. Mr. Alston Grimes, of Pitt County, a vice-president of the Association, was introduced and gave an interesting talk on the profits in forest management in Pitt County, and the efforts being made to keep out fires.

He told first of a neighbor of his who bought a tract of land for \$500 from which he had sold \$3,500 worth of timber, retaining still the land and much of the timber. The neighbor, he said, had preserved the forests by prohibiting hunting. "I have not been successful myself in this respect," Mr. Grimes said, "but after giving written permission I do not allow the hunter to carry an axe and chop the 'possum tree down."

Mr. Grimes said he required all of his tenants to pay five dollars an acre when fire is allowed to run over land for which they are responsible. "They think it is a hardship at first, but agree afterwards that it is the right thing."

Mr. C. C. Smoot, III, of Wilkes County, another vice-president, then gave a short account of the Wilkes way of fighting fires where a neighborhood war was waged against the blazes of the community. He said he had become greatly interested in the fight against the blight which is killing the chestnut trees in the States to the north of us and which threatens to invade our own State.

Mrs. Al Fairbrother, a delegate from the Woman's Club of Greensboro, was then called upon by the President to say a word upon the subject from the viewpoint of the ladies. She said she had not come as a speaker or as a suggester, but as a learner. She said that the Woman's Club in Greensboro was going upon the principle that one of the chief civic works was to educate the children in conservation. She told of some of the work done by the ladies of Greensboro, such as the recent establishment of a children's playground there, which is the first public playground in North Carolina. This was accomplished entirely through the work of the Civic Association.

The President then called on Mr. W. D. Johnson, a colored man who is Agent of the United States Forest Service now temporarily stationed

at the colored Agricultural and Mechanical College at Greensboro, to say a few words about the interest of our colored citizens in forest protection.

Mr. Johnson declared that as poor a man as he is, he would have declined a gift of \$500 rather than have been kept from this meeting. He was born in the old country, he said, and had not known what the dominant race has done for the colored people until he came to the South. "I want to say," he said, "that not half what has been written and said about this question is true." He declared that as an agricultural race, a knowledge of forestry would be a great help to them.

Mr. J. G. Peters, Chief of State Coöperation in the United States Forest Service, who had come down from Washington especially for the meeting, then made an address on "State Coöperation in Fire Protection With the United States, Under the Weeks Law."

COOPERATIVE FIRE PROTECTION UNDER THE WEEKS LAW.

BY J. G. PETERS, UNITED STATES FOREST SERVICE.

Members of the North Carolina Forestry Association, Ladies and Gentlemen:

The protection of our forests from fire is receiving increased attention throughout the country. It is the result not only of the enormous amounts of timber destroyed, but especially of the constantly growing value of timber. The loss in the coniferous forests of the North is frequently the destruction of the merchantable timber itself, while in the pine and hardwood forests of the South the chief damage is the repeated killing of young growth, especially on cut-over lands. This young growth has a very great future value, for upon it depends the permanency of the lumber industry in the region.

Fire also destroys the soil covering, causing rapid run-off on steep slopes and erosion is chiefly the origin of sediment in the channels of navigable streams. This injury to streamflow and navigation furnishes ground for active assistance from the Federal Government. A year ago Congress passed the Weeks law, section 2 of which is designed to authorize this assistance.

The purpose of this section of the law is primarily to protect navigable streams, and secondly to promote forest protection by the States and private owners. The appropriation for the purpose is \$200,000, which is available until expended. The law requires that (1) the protection must be confined to the forested watersheds of navigable streams; (2) the State must have provided by law for a system of forest fire protection; and (3) the Federal expenditure in any State must not exceed in any Federal fiscal year the amount appropriated by the State for the same purpose for the same fiscal year.

The law is administered by the Forest Service under an agreement between the Secretary of Agriculture and the State.

A broad interpretation has been placed on what constitutes a navigable stream, and in every case the stream is given the benefit of any doubt. However, streams used only for floating logs, canoes or rowboats are not consid-

ered navigable. As a general basis for decisions on the question of navigability the reports of the Chief of Engineers, United States Army, are used.

The work is being conducted on a conservative basis and the fund available for the purpose used so as to encourage local effort in as many different States as possible. The educational value of the work is very great, and the Government desires every State that can fulfill the requirements to receive a share of the fund. Our policy is to make the appropriation last three years. The expenditures in 1911 were practically \$39,000. The allotments for 1912 will aggregate about \$70,000. No State receives more than \$10,000 in any one year.

The aim is to assist each State as far as possible, helping especially the one that has a hard time helping itself. The State that can make only a small appropriation may have it duplicated, while the one that has an appropriation which is relatively very large and can of itself provide safe protection must expect a relatively small allotment.

The coöperative agreement provides that the State supply the Service with a comprehensive fire plan, including maps showing the areas to be protected, the headquarters and approximate routes of patrolmen, and all features necessary to a clear understanding of the State's plan of fire control.

The expenditures made by the Federal Government are exclusively for the salaries of patrolmen, including men assigned to lookout duty, railroad patrol, and the like. This is advisable in order to simplify the Federal inspection of the work. The expenditures of the State, which are to offset those of the Federal Government, may, however, properly include any expenditure for the purpose of protecting forested watersheds of navigable streams from fire. The construction of lookout stations or other protective facilities and proportionate amounts of supervisory expenses are proper charges on the part of the State against the expenditures made by the Federal Government. A distinction is made between State patrolmen and Federal patrolmen, which facilitates keeping separate the work charged to the State and that charged to the Federal Government.

The State Forester or similar officer is given a Forest Service appointment, which permits him to employ Federal patrolmen and certify to their services on Government vouchers. He is given as much authority and latitude as possible in the expenditure of Federal funds. The Forest Service places him in practically the same position as a National Forest Supervisor by allowing him a wide degree of discretion while at the same time making him fully accountable for results. He selects the Federal patrolmen, instructs them in their duties, and supervises their work.

The Federal patrolmen must have such police powers for the prevention and control of forest fires as the laws of the State provide; they must be authorized to employ assistance in fighting fires; and they must be equipped with fire fighting tools.

The Forest Service inspects the coöperative work on the protected areas, and can withdraw its approval of any area or terminate the employment of the State officer or any Federal patrolman.

The States which received Federal aid under the Weeks law in 1911, and the amounts expended by the Government and the States are shown in the following summary:

State	*State Expenditures	Federal Expenditures	Allotment to States	UNEXPENDED	
				Balance of Allotment	Balance of \$200,000 Fund Jan. 1, 1912
Maine.....	\$ 23,557.07	\$ 9,991.80	\$ 10,000.00	\$ 8.20	
New Hampshire.....	13,876.21	6,219.50	7,200.00	980.50	
Vermont.....	2,243.90	1,218.00	2,000.00	782.00	
Massachusetts.....	400.12	365.00	1,800.00	1,435.00	
Connecticut.....	513.96	6.00	1,000.00	994.00	
New York.....	3,837.59	2,000.00	2,000.00	0.00	
New Jersey.....	1,241.50	990.00	1,000.00	10.00	
Maryland.....	262.85	261.00	600.00	339.00	
Wisconsin.....	20,841.87	4,437.25	5,000.00	562.75	
Minnesota.....	25,675.77	10,000.00	10,000.00	0.00	
Oregon.....	8,758.89	3,305.00	5,000.00	1,695.00	
Total.....	\$ 101,209.73	\$ 38,793.55	\$ 45,600.00	\$ 6,806.45	\$ 161,206.45

* As shown on State vouchers or statements forwarded with Federal vouchers. These vouchers are not necessarily the total State expenditures.

The watersheds that received coöperative protection were the following:

Maine—Narraguagus, Union, Penobscot, and Kennebec.

New Hampshire—Androscoggin, Saco, Connecticut, and Merrimac.

Vermont—Connecticut, Otter Creek, and Hudson.

Massachusetts—Nashua, Thames, Connecticut, Housatonic, and Hudson.

Connecticut—Thames, Connecticut, and Housatonic.

New York—Hudson and Delaware.

New Jersey—Hackensack, Passaic, Delaware, and Raritan.

Maryland—Potomac and Youghiogheny.

Wisconsin—Chippewa and Wisconsin (headwaters of the Mississippi).

Minnesota—St. Louis, Rainy, Mississippi, and Red River of the North.

Oregon—Columbia, Willamette, Nehalem, Wilson, Siletz, Umpqua, Coos, Rogue, and Klamath.

There were five hundred and nine Federal patrolmen employed, of which about two hundred were on continuous pay from the date of appointment to the end of the season. They received from \$2 to \$2.50 a day. Each had a district to guard varying in area from about 25,000 to 100,000 acres. Without necessarily attempting to cover the whole district he made his rounds of the dangerous places on the most valuable areas at the most advantageous times. The routes he followed varied from ten to forty miles a day, depending on the method of travel, usually on foot, horseback, or bicycle, whichever was the most feasible. Along the railroads, except where oil was burned, there was a special and continuous patrol, in some places on foot and in others on velocipede or bicycle.

The patrolman carried a map of his district and adjoining districts, showing the major topographic features, approximate location of the Federal and State patrol routes, patrolman's and fire warden's headquarters, and such improvements as telephone lines, lookout stations, roads, trails, tool supply boxes, and the like, as might be necessary to aid him in emergency. He also carried some fire fighting tool like a shovel or collapsible canvas pail.

The most important duties of the patrolman were putting out small fires, warning persons he met of the fire danger, and recording their names wherever advisable. In the case of larger fires, where assistance was necessary, he had authority under the State law to call out help to extinguish them.

Often fires were left unextinguished by camping parties; fishermen stopped to cook a meal and left the fire burning; many fires were also caused by smokers and locomotives. The patrolmen found hundreds of such fires as these on their routes last season and extinguished them.

In addition to regular patrol duty and fire fighting, there was other work, which included the watching for fires from lookout stations, burning slash, and constructing protective improvements.

Besides the practical tangible results of the coöperation under the Weeks law, which have been apparent from the start, its educational value, although not measurable, has been far reaching in effect. Except in a few States, last year was the first that any systematic patrol of the forests by the State had ever been done. It marked the general extension of the State organization, in coöperation with the Federal Government, getting out among the people; educating them, through the actual work done, in the need of fire protection, and soliciting their coöperation.

The most effective work of the patrolmen was in warning persons met in the woods of the danger from fire and informing them about the fire laws. The patrolmen were instructed generally to record the names and addresses of fishermen, hunters, and campers wherever possible, and send them to the district chief. In New Hampshire, for example, 4,200 warnings of this sort were given. Over half the names were recorded and are now on file in the office of the State Forestry Commission. Before the next fire season a copy of the fire laws will be sent to each of these persons. The educational value of this work can not be questioned.

The result of the warnings given and the other protective measures adopted is that the public is coming to know something about the forest fire laws of the State and the practical value of fire protection. Loggers and those who traveled the woods began taking greater care in the use of fire; quicker notifications of fire were given to the proper State officers, where before they had at best been desultory; in many cases private owners, who were skeptical at the start, later saw the practical value of the work and began contributing to it by the hire of patrolmen, building lookout stations, and the like; and the increased interest of the public was shown by the widespread demand for information on fire protection received by the various State foresters and the Federal Forest Service.

The first question that naturally occurs to one looking for measurable results is just how far the expenditures succeeded in saving possible losses. Maine and New Hampshire furnish very good examples of comparative losses in 1911 and 1903, two of the most dangerous fire years on record in these

States, on the watersheds where coöperative fire protection was established last year by the State and the timberland owners with the Federal Government.

Year	Season of Drought	MAINE		NEW HAMPSHIRE	
		Acres Burned	Damage	Acres Burned	Damage
1911	April 16—June 1	91,471	\$ 154,284	10,925	\$ 34,036
	June 20—July 17				
1903	April 17—June 6	172,040	679,423	84,255	200,000

While the danger season of 1911 was the longer, and was considered generally to be the more severe, still the area burned over and the value of the damage were considerably less than in 1903. This is very significant. The decrease can unquestionably be attributed largely to the protection afforded in 1911 as compared with the almost utter lack of it, except by some few private owners, in 1903.

The Federal Government desires to extend this coöperative protection to other States. To secure its benefits they must enact a forest fire law and appropriate funds for administering it. There are many States which could take hardly a more effective step toward the conservation of resources which support important industries than to inaugurate systematic fire protection. The fact that the immediate financial interests of timber owners make them backward in undertaking this insurance of their industry is an additional reason for the States to take the lead. The readiness of the Federal Government to coöperate with the States, under the terms of the Weeks law, as soon as they make a start is an incentive to immediate action.

A State fire law should provide, in addition to an organization to fight fires, a patrol force to prevent fires, as far as possible, from starting. The law should, of course, carry an adequate appropriation. A general defect in State forest fire laws is that they provide only for fighting fires and not for a patrol. Their most serious handicap is the inadequacy of the appropriations. To protect the national forests costs about two cents an acre annually; the Biltmore tract in this State, about five cents an acre; and the lands of the various timberland protective associations in the northeastern and northwestern States, from two to four cents an acre. It is probable that a State can secure efficient protection for one cent an acre, if the larger private owners will assist by contributing toward the protection of their own lands. If, for example, a State has five million acres that need protection, an annual expenditure of \$50,000 should be sufficient to handle the work effectively. It is improbable that the State would appropriate this amount at the beginning. An appropriation of \$10,000 or even less would be sufficient to start the work and demonstrate its value.

It will interest you to know what the States appropriate yearly for fire protection. Maine appropriates \$68,000, New Hampshire \$12,000, Vermont \$2,300, Massachusetts \$10,000, Connecticut \$2,000, New York \$100,000, New Jersey \$15,000, Pennsylvania \$50,000, Maryland \$1,500, Michigan \$10,000, Wisconsin \$35,000, Minnesota \$75,000, Idaho \$12,000, Washington \$38,000, and Oregon \$30,000.

I can not urge too strongly the adoption by North Carolina of a forest fire protective system with an adequate appropriation to meet its expenses. The State, which is so rich in timber resources, can then avail itself of the benefits offered by the Weeks law.

At the request of the President the discussion on Mr. Peters' paper was postponed until after the next paper, which gives a view of the same subject from the standpoint of one of the States which is now coöperating with the Federal Government in fire protection.

In the unavoidable absence of Mr. F. W. Besley, State Forester of Maryland, his paper was read by the Secretary. His paper follows:

FOREST PROTECTION AS APPLIED IN MARYLAND UNDER THE WEEKS LAW.

BY F. W. BESLEY, STATE FORESTER OF MARYLAND.

The limited way in which Maryland has been able to participate in the benefits of the Weeks law has shown that it is a good thing and makes us anxious to do more along this line. Since forest conditions in North Carolina are somewhat similar to those in Maryland, our experience in this connection may have some suggestive value, at least.

In order that any State may take advantage of the coöperative offer of the Federal Government in fire protection, there are three conditions that must be fulfilled. First, the State must have adequate fire laws, giving full authority for inaugurating a policy of forest protection; second, there must be a suitable organization for carrying into effect these laws, that full benefits may be secured; and third, the State itself must appropriate money for the purpose of fire protection, as the Federal Government, under the Weeks law, will not, in any case, spend more money than the State spends for the same purpose during the same time.

There are certain other limitations upon the expenditure of the Federal allotments, such as limiting it to patrol and lookout station work, on the watersheds of navigable streams in the mountain sections, but under conditions that exist in Maryland and in North Carolina these limitations will probably not reduce the usefulness of the work.

Maryland has a good forest fire law and a forest warden system for putting the law into effect. The State has been expending about \$1,200 annually for forest fire protection, so that we were able to take advantage, to a small extent, of the Federal coöperation. An arrangement was made for the fall of 1911, whereby the State allotted \$600 and the Federal Government a like sum for fire protection. Seven mounted patrolmen were employed at three dollars per day to patrol on days when the woods were dry enough for fires to burn. The patrolmen were selected by the State Forester and worked under his direction, so that there was no interference whatever with the State forest organization. These men were selected with great care, for the work that they were called upon to do required tact in dealing with the mountain people. Furthermore, the number of patrolmen employed and the amount of money available was so small that close supervision was not practicable; hence the necessity of securing men that could be fully relied upon.

The fall of 1911 was unusually wet, so that the efficiency of the patrol work was not fully tested. Only eight fires were reported during the season. These were all small fires, discovered by the patrolmen soon after they started and promptly extinguished before any serious damage was done. The fact that these small fires were discovered and extinguished before they assumed serious proportions demonstrates fully the value of the patrol service. Under our forest warden system, the Forest Warden is not authorized to incur any expense in patrol work, or to do anything until after the fire has been reported to him, and, generally, the fire has done considerable damage and is difficult to control by the time it comes to the attention of the Forest Warden. Under the patrol system this trouble is largely overcome, and certainly for the mountain district, where there is a large percentage of woodland in continuous bodies, the patrol system is the practical method of dealing with the forest fire question. The State Forester outlined for the forest patrolmen and the regular State forest wardens, a plan of coöperation by which each was to work in harmony, and it is gratifying to report that this plan, so far as it could be observed under the limited opportunities for action this fall, worked out very satisfactorily.

EDUCATIONAL VALUE OF THE WORK.

Considerable stress was laid upon the educational feature of the work during the past season. The patrolmen were provided with printed matter relating to our forest fire laws and fire protection, and they were instructed to avail themselves of every opportunity to place this literature in the hands of landowners in their district and to talk with them on the subject of fire protection. While it is difficult to measure the effect of this work, it is believed that it has been instrumental in securing a more thorough coöperation on the part of the landowners of the mountains in suppressing forest fires. The landowners have, in every case, shown their willingness to coöperate, and now that their attention has been called to the forest laws, and the determination on the part of the State and Federal governments to aid them in securing fire protection, they have been encouraged to hold an entirely different view toward the forest fire question. It was just such work as this which was required to crystallize the sentiment and make it effective. The forest patrolmen not only visited the landowners in their districts, posted warning notices, and warned the careless, but also visited the schoolhouses and got the teachers interested. Our forest laws are sufficiently comprehensive to cover the situation and to meet any emergency that may arise, but it is just such an agency as this patrol which creates a public sentiment that will make their enforcement certain. The fact that the Federal Government is paying men to patrol the woodlands and enforce the forest fire laws carries with it a dignity and force which can not fail to arouse the admiration and good will of the people generally. I feel reasonably certain that these results have been secured in the Maryland work.

VALUE OF FEDERAL COOPERATION IN FIRE PROTECTION.

Under present conditions in Maryland, the State can not fail to appreciate fully the coöperation of the Federal Government. As has been stated, our forest laws are excellent in many respects. The Forest Warden Service has

been in operation for some time, but the whole system has shown its weakness in not making any provision for fire patrol and an utter lack of funds to carry on the protective work. The coöperation of the Federal Government, under the Weeks law, solves for us one of these great questions, namely, the forest patrol. Outside of the mountain counties the forests are generally held in woodlots, or isolated wooded tracts, where a fire patrol is less important. With the Federal coöperation, however, we are able to meet this situation without a change in our forest laws. The question, however, of increased appropriations for fire protection work is yet unsolved, but the fact that the Government has agreed to practically duplicate the amount we spend for fire protection purposes is the strongest kind of an argument that could be used for securing a special appropriation for forest protection from the Legislature this winter. The very limited amount that we had to expend has greatly curtailed the amount that could be secured from the Federal Government, but it has strikingly shown the need of extending the work.

A general discussion of the subject of coöperative fire protection under the Weeks law was then taken up, Mr. Alston Grimes and Mr. E. A. Blake of the Norfolk and Western Railway taking a prominent part. In answer to a question, Mr. Peters said that the implements of warfare in firefighting were the hoe, the rake, and the collapsible canvas bag. In regard to the pay we shall give to patrolmen, he said that various wages were paid, some receiving compensation by the hour, others by the month. He declared that volunteers are supported by the State and compensation to them varies from fifteen cents or twenty cents to fifty cents an hour.

Mr. Hugh MacRae, of Wilmington, then read an address on the "Stock Law and Forest Protection," prefacing his remarks with the statement that his subject was not a popular one, and giving as one of his reasons that men are not naturally lovers of effort.

THE STOCK LAW AND FOREST PROTECTION.

BY HUGH MACRAE.

The question of Stock Law in its relation to forestry is so simple that it could be covered by a few emphatic sentences, but as this would savor of dogmatism and would not further the economic interests which we have met here to consider, I am going to ask you to let me surround the bare statement of facts with certain bits of information which I hope will emphasize the importance of this subject.

I shall speak of the longleaf pine forests of the coastal plain, because the problem there is simple and will serve very well to illustrate the subject. As to these forests of the coastal plain, could Nature have been more prodigal? Could we have been less appreciative? Here is a tree, the longleaf pine, of the very highest economic value, absolutely suited to soil and climate, which Nature insists on reproducing.

One growing or defective tree, left standing for two or three years after its fellows are taken, will reforest two or three acres of ground.* The pine burrs begin to pop open on the coming of cold weather in October or November and scatter the winged seed or "mast," which is whirled in every direction by the prevailing winds of the winter. Almost every seed can germinate, for it falls on an ideal seed bed of sandy loam, which is kept almost constantly moist by the frequent rains.

After a few warm days the seed sprouts and puts down its small tap root. As soon as the tap root digs its way into the sand it performs one of the miracles of Nature by straightening up and lifting the mother seed into the air. Now the little tree is nourished from below and fed from above. It is fed through the tips of the pine needles until all proper dangers are passed; and with the warm days of spring it soon is six inches high, and by fall it is firmly established in the soil.

Compare this with the slow, expensive process of reforesting in Europe (with trees of far less value), where each tree is planted and replanted by hand.

It may be interesting to you to know that while I have been accustomed to going into the woods all my life, I never had the opportunity to observe the growth of the young longleaf pine from the seed, as above described, until after the stock law was passed in New Hanover County a few years ago. The hogs ran at large in that county and were so strenuous that they succeeded in making this phenomenon one rarely to be observed. Now you can see the longleaf pine reproduce itself everywhere.

Recently a gentleman from New York, who spoke Italian fluently, was questioning an Italian at St. Helena about the results obtained from the vineyards of the colony. It was noticeable that the Italian replied with great enthusiasm, and later when the gentleman was asked what was said he replied that there were no expressions in English to give the exact idea; but as near as he could express it the Italian said, "We can not understand why Nature has done so much for us, why she is so bountiful with the harvests. We feel that she has made a mistake."

The area of the coastal plain is somewhat in excess of ten million acres. If the value of reforestation is duly appreciated and the forests protected, there should be an increase of at least four million dollars per year to the value of the forests from the natural reproduction.

Can Nature do more for us in the way of providing forests? Why has she been so generous in soil and climate, in abundance of moisture? We can quite understand the Italian's point of view.

When we think of the vast areas of the earth's surface not adapted to reforestation and others where the forests, once destroyed, can not possibly be reproduced, we ought to be thankful and protect intelligently what has come to us as a gift.

At the moment we can not feel proud of the part man is playing. Because of ignorance and natural aversion to effort, he sets fire to the woods in order to give the benefit of the new growth of almost worthless grasses to almost worthless cattle, which are enabled thereby to get a scanty living. He ranges his hogs in the woods, when they would prove far more profitable if

* A forester would recommend leaving at least one seed tree per acre, and preferably two, to make the reforesting from seed quicker and more sure.—Editor.

kept at home. From the time the pine mast falls* until the little tree is one year old it affords a natural delicacy for the hogs—but only a delicacy, from the fact that a hog has to cover so much territory to live on this scattered food that he evolves into a high-speed brute, like Kipling's "kangaroo."

The fires and the hogs are enough to complete the destruction; but add to these a few sheep which have the habit of eating the conelike buds out of the tops, and the little trees, which have escaped other enemies, are killed.

Without being in possession of any figures obtained by scientific investigation, it might be safe to say that one fire-spreading man, with twenty hogs, twenty sheep, and ten cows, will keep ten thousand acres devastated.

Nature does not give up the fight, however. She attacks the hogs with cholera, the cows with tick fever, and the man with poverty; but with what terrific cost to civilization!

Let me tell you of one tract of ten thousand acres which reforested itself. The seeding period was fifty years ago when men were in the war and when hogs and cows were scarce. About one-half the timber on this tract is longleaf pine; the other half is shortleaf pine. The reforestation did not cost the owner one cent. As it came easily, it was sold cheap; land, timber and all for \$27,000. During the past five years this tract has paid the owners \$27,000 in turpentine rent; has paid to the renter more than \$100,000, I understand, in the value of the turpentine. The timber is worth at present stumpage prices over \$50,000; and on a good market would be worth more than \$75,000. The sawed value of the timber would probably be worth as much as \$500,000. As the land alone is worth much more than the purchase price, we can see that Nature's gift on this tract must be considerably in excess of \$200,000; or more than \$4,000 per year. While this land has probably been fire swept during recent years, the pine tree after it is several years old fortunately has a bark which will stand fire. The fire retards its growth, but does not kill the tree after the first few years.

A friend told me of an experience he had in the pine belt where there was no stock law. He bought about five hundred acres from which the pine trees had been cut. About six years ago he fenced ten acres of it. Recently he visited the place and found all the land outside of the fence just as he had left it years ago. Inside of the fence was a beautiful growth of longleaf pine, not less than one hundred trees to the acre. This man is naturally a strong advocate of stock laws which will protect the forest.

In this connection it is well to consider the worthlessness of woods cattle. This was brought home to me recently. Some parties joined in a plan to carry on a small cattle feeding and dairying experiment, which was to be enlarged if it proved a success. The manager was a Hollander who, while he understands cows, was a stranger to the cattle and methods of this country. He was struck with the cheapness of the woods cow and thought he could start with these and improve them. After feeding about forty head of woods cattle until they had about consumed their value in feed, and after going through the trials of tick fever and working with the cattle all fall and winter, it became perfectly clear that the wise thing to do was to dispose of them and start over again; and the owners were glad to sell the cows

* Nearly all of the seeds of the longleaf pine are devoured by hogs before they have time to germinate. Those that by some lucky chance escape, and become seedlings, are rooted out, even after they reach several years of age, the succulent roots of the pine being relished by the hog.—Editor.

at their original cost price, losing one-half of the capital, which had been used up in expenses.

Do we want forests? Yes. Not only because of their economic value in furnishing fuel, cross-ties, and material for building and for the manufacture of furniture; but because they help to regulate the rainfall and conserve the water supply, which is essential to the prosperity of the agriculturist; and because the forests have a favorable influence on the climate, making it more equable by protecting the country against the sweep of cold winds.

In an article written by W. J. McGee, which appeared in a recent issue of the *World's Work*, it is made clear that the power of this country to support a very large population, one billion, with comfort, is directly measurable by the amount of available water supply—namely, the annual rainfall and that stored under the surface of the earth. He says: "The limit of our capacity for production and population lies not in the land or its living forms—both susceptible of immeasurable improvement—but in the supply of water on which life depends; for without water there are no plants, no soils, no animals, no men, no intelligence to control lower nature."

With the abundance of rainfall which we have in North Carolina, the great future of the country undoubtedly lies in the direction of intensive farming. If it is water and not land which sets the limits to population, and the chief feature in preserving our water supply is the care of our forests, then indeed we must handle this problem without delay. Twenty-five acre-feet of water per year on five acres of land will enable a family of five persons to support themselves with comfort and contribute to the support of an equal number of persons engaged in manufacturing or other kinds of work. With ample water, in other words, five acres will yield an easier living than 640 acres, or a square mile, on the plains; and eastern North Carolina will support easily one person per acre. In Holland there is a section where five hundred people are comfortably supported on fifty acres of land.

I wish I had the eloquence to demonstrate convincingly that because of this fact of abundant rainfall we of North Carolina live in one of the most favored spots on the globe; but we are not rising to the level of our natural surroundings. We are allowing generation after generation to go by and miss this miraculous opportunity. It seems that we must suffer by falling short of our birthright. It is common sense to proceed along the lines of least resistance, and to do the thing which can be done to greatest advantage.

We have met to consider ways of protecting the forests. It is obvious that forest fires must be avoided, and that ranging cattle and hogs must first be stopped.

The United States Department of Agriculture and the State Department make clear to us the great loss of profits to the farmer from tick fever and cholera, which are directly due to permitting scrub cattle and woods hogs to run at large. This information is interesting; but to be valuable we should apply the real remedy, which is the adoption of a *State-wide stock law*. If some of our farmers in certain sections are still too ignorant to be alive to their best interests, it is the duty of those who do understand this to insist that our Legislature shall take care of this matter. A development in one progressive line assists every other, and I think nothing will do more to help drainage projects, the building of good roads, better education, better home

comforts, and more profitable agriculture, than the passage of a stock law; and these things mean the development of our country.

A State stock law, then, means that a man shall keep his cattle, hogs, and sheep fenced in, instead of permitting them to roam at pleasure over the lands of other persons. If he owned sufficient land so that his hogs and cattle could range freely without interfering with others, we would not be so much interested in the problem; but even though this man owned land he does not have the rights over rainfall and climate. These are for the common good.

It is the function of good government to promote the welfare of the governed, to protect the weak against the unfair encroachment of the strong, and to do whatever is best for the interests of the majority of the people.

If forests are for the general good, and the protection of forests is advantageous to our civilization and necessary to our comfort, then we are justified in asking our Legislature, which should be composed of intelligent representatives and statesmen, to make the laws necessary for the protection of the forests.

Mr. MacRae's paper was listened to with profound attention, and was received with applause. In the discussion which followed Professor W. N. Hutt, of the State Department of Agriculture, stated that an unintelligent or "stand-pat" farmer had recommended to a more progressive one the rearing of hogs in the woods, as they could there get their own living. On being asked what he thought it cost per pound to raise such meat, the "stand-pat" farmer replied that he thought it cost nearly nothing. The progressive farmer, after showing the large amount of land that was run over by these hogs and the small amount of pork that was produced per acre and per one hundred dollars invested in this land, declared that in his opinion range pork cost three dollars per pound.

REPORTS OF COMMITTEES

REPORT OF COMMITTEE ON RESOLUTIONS.

Mr. C. P. Heyward read the report of the Resolutions Committee, which recommended the following resolutions:

RESOLUTION No. 1.

WHEREAS, The North Carolina Geological and Economic Survey has been commissioned by the Legislature to make investigations and recommend plans to the people and the Legislature for the improvement of the forest conditions of the State; and,

WHEREAS, The Survey has done and is doing as much as possible in this way with the limited amount of money at its disposal: be it

Resolved, That the North Carolina Forestry Association do endorse the work of the Survey, and do hereby show its appreciation of the assistance the Survey has given to this Association; and,

Resolved further, That we hereby memorialize the next Legislature to liberally support this branch of the work of the North Carolina Geological and Economic Survey.

RESOLUTION No. 2.

WHEREAS, The Weeks Act provides an appropriation of \$200,000, available until exhausted, to enable the United States Government to cooperate with States in protecting from fire the forested watersheds of navigable streams; and,

WHEREAS, No State can take advantage of this offer of cooperation unless it has some paid system of forest fire protection: therefore, be it

Resolved, That the North Carolina Forestry Association urges upon the people of the State and upon their Representatives to the General Assembly who are to be elected during the coming summer the necessity of North Carolina's passing legislation which will enable her to receive this assistance from the Federal Government for the protection of her forests.

RESOLUTION No. 3.

WHEREAS, We realize that a better understanding of the value of our forests and the need for more conservative methods in handling them has got to begin with the younger generation: therefore, be it

Resolved, That we hereby advocate the introduction into our schools and colleges of elementary courses in forestry, which will give the children of the State a better appreciation of the worth of these most valuable natural resources; and,

Resolved further, That we heartily second the efforts of the Federation of Women's Clubs to have a forestry course introduced at our State University; and,

Resolved further, That we heartily endorse the efforts of the North Carolina Geological and Economic Survey to make general the observance of Arbor Day in our public schools, and we do hereby respectfully request the State Board of Education to require the annual observance of Arbor Day by the schools of North Carolina.

RESOLUTION No. 4.

WHEREAS, The annual yield from the forests of this State is exceeded only by the yield of cotton and corn; and,

WHEREAS, These forests are being cut at a much faster rate than they are producing timber, which will increase the demand for our second growth forests year by year; and,

WHEREAS, Forest fires annually destroy not only large amounts of merchantable timber, but also immense areas of young growth which ought to be reserved for the future use of our citizens: therefore, be it

Resolved, That the North Carolina Forestry Association advocates a State system of fire protection supported by an appropriation of the Legislature, to be administered by a technical and nonpartisan organization for the protection of all the timber lands of the State.

RESOLUTION No. 5.

WHEREAS, A virulent fungus disease, known as the Chestnut Tree Blight, has already infected a large portion of the chestnut region of the New Eng-

land States, of New York, New Jersey, Pennsylvania, and Maryland; has entered and gained a foothold in Delaware, Virginia, and West Virginia, and threatens the destruction of this valuable timber tree in our own State; and,

WHEREAS, North Carolina and the other States not yet reached by the infection are justly entitled to every possible help and protection which Congress and the States themselves may be able to employ in saving their chestnut timber from attack: therefore, be it

Resolved, That the North Carolina Forestry Association pledges its support in arousing the public to recognize and combat this disease; and,

Resolved further, That this Association urges the Representatives of North Carolina in Congress to support a bill now pending before that body appropriating \$80,000 for the use of the United States Department of Agriculture, to be used in a thorough study and investigation of this tree disease, with the view of devising ways and means to combat its further spread, and to subject it to possible control.

Resolved further, That this Association bring this matter as soon as possible to the attention of the next General Assembly of North Carolina, with a view to making an appropriation, if then found advisable, towards protecting this State from this disease.

RESOLUTION No. 6.

WHEREAS, The indiscriminate ranging of stock through the open lands of both Eastern and Western North Carolina is a menace to the perpetuation of the forests of these regions through the destruction of the seed and young growth by stock, and because many of the forests fires indirectly result from this ranging: be it

Resolved, That the North Carolina Forestry Association heartily favors the extension of the stock law to those parts of the State which are now without this advantage.

RESOLUTION No. 7.

WHEREAS, Numerous fires are caused by sparks from locomotives: be it

Resolved, That the Legislative Committee be instructed to prepare a bill to be presented to the next General Assembly, requiring railroads to place spark arresters on all locomotives within one year after such act is passed; and,

Resolved further, That this Association request all civic clubs and similar associations to hold meetings with this object in view, and endeavor to pledge their Member of the General Assembly to support such bill when introduced.

RESOLUTION No. 8.

WHEREAS, The pine timber in many of the counties of the State has suffered enormous injury from the attacks of the Southern pine beetle, to the serious loss of the farmers and other timberland owners of the State; and,

WHEREAS, The United States Bureau of Entomology has studied this question thoroughly and worked out a method of control, which, if carried out, would free our State from this pest, and has advocated this plan both in the press and in public meetings in this State: be it

Resolved, That the North Carolina Forestry Association recognizes with appreciation the efforts of this Bureau to suppress this pest in North Carolina; and,

Resolved further, That this Association pledge its support to the further efforts of this Bureau and of the North Carolina Geological and Economic Survey, which is coöperating with this Bureau in this work; and,

Resolved further, That the question of more efficient coöperation through the Survey be brought to the attention of the next General Assembly, with the hope that an appropriation will be made to carry on this work more generally than they can now do.

These resolutions were unanimously adopted by the Convention.

REPORT OF COMMITTEE ON NOMINATIONS.

Miss Annie F. Petty reported for the Committee on Nominations, nominating the following gentlemen as officers for the ensuing year: Mr. E. B. Wright, of Bladen County, for President; Mr. J. S. Holmes, of Chapel Hill, for Secretary-Treasurer. The report of the Committee on Nominations was then adopted, and Mr. Wright was elected President, and Mr. Holmes was reëlected Secretary-Treasurer.

The constitution which had been drawn up and previously approved by the Executive Committee was then read by the Secretary, and was formally adopted by the Association.

CONSTITUTION OF THE NORTH CAROLINA FORESTRY ASSOCIATION

Name: The name of this Association shall be the North Carolina Forestry Association.

Object: The object of this Association is to promote the protection of the forests of North Carolina from fire and from destructive insects, and to promote their perpetuation by wise use and by the reforestation of cut-over and abandoned lands.

Office: The official headquarters of this Association shall be located and maintained at the office of the Secretary.

Membership: The membership of this Association shall be composed of all who have registered with the Secretary and all those who may hereafter apply to the Secretary and have their names enrolled as members.

Officers: The officers of this Association shall consist of a President, a maximum of thirty-nine Vice-Presidents, one from each Senatorial District of the State, and a Secretary-Treasurer, who shall hold their respective offices for one year, or until their successors shall be duly elected and qualified. In the absence of the President or his inability to perform the duties of his office, the Vice-President for the district in which the meeting is held shall act in his stead.

Executive Committee: The Executive Committee shall consist of the President, the Secretary-Treasurer, and five other members of the Association, to be named by the President. At all meetings of this committee three members shall constitute a quorum for the transaction of business.

Duties of Officers: The President shall preside at all meetings of the Association and of the Executive Committee, and sign all orders on the Secretary-Treasurer, and perform all other necessary duties in furtherance of the purposes of this Association.

The Secretary-Treasurer shall keep the records, books, and accounts, shall be the custodian of the funds of the Association, and disburse the same upon the order of the President, and perform the other usual duties incumbent upon such office.

The Executive Committee shall have charge of the affairs of the Association pertaining to its business, provide ways and means for its proper finances, and perform all things necessary for the promotion of its interests.

Meetings: The annual meeting of the Association shall be held at such time and place as may be agreed upon by the Executive Committee. Notice of such meetings shall be mailed to each member of the Association at least two weeks prior to the date of meeting. Special meetings may be called by the President or by the Executive Committee.

The Executive Committee shall hold its regular, stated meetings at such times as it may select, and may adopt rules and regulations for the government of itself and the business of the Association.

Notice of special meetings as above provided for shall be mailed to each member of the Association at his last known post-office address at least ten days before the date of such meeting. Such notice shall set forth the object for which such meeting is called.

Dues: The annual dues shall be one dollar a year.

Amendments: These articles may be amended at any regular meeting of the Association by a majority of the votes cast.

The report of the Auditing Committee was made by Mr. D. A. White, approving the Treasurer's report.

This report of the Treasurer, for the year ending February 19, 1912, shows a total in receipts of \$102, disbursements \$52.25, leaving a balance on hand of \$49.75. Twenty-two subscriptions of one dollar each were received, the remaining eighty dollars having been given in two handsome donations by the John L. Roper Lumber Company and the Butters Lumber Company. The disbursements were all for stamps and stationery. The above balance will, however, be largely eliminated by the expenses of the Convention.

Several short talks were then made by delegates and guests of the Convention.

Mr. H. M. Cates, of Graham, N. C., representing the North Carolina Farmers' Alliance, said that he had been sent here to hear what was going on. "The farmers, I believe," he said, "are with you. I don't belong to your organization, but I have got my dollar with me and I am going to join. Our motto in regard to the forests seems to have been 'Take no thought for the morrow.' We have, however, got to protect our forests against the fires and careless men."

Mrs. R. R. Cotten, President of the North Carolina Federation of Women's Clubs, spoke of her intense wish for the perpetuity and continuity of the longleaf pine forests of the State. The women's clubs are

doing what they can to get forest preservation taught in the public schools. The women of the State are with this Association in this work.

Colonel J. Bryan Grimes spoke with force and conviction on the evidently increasing enthusiasm of the people in this matter. He declared that if there were one thousand farmers like Mr. Cates in North Carolina there would be a revolution in the State upon forest protection.

He called the attention of the men present to the ruthless destruction of the trees and even the lands, by the unintelligent handling of the timber when gotten out by the mill men. It destroys not only the undergrowth, the forests of tomorrow, but hurts the lands. He spoke of the trifling prices which timber had been sold at in the past. He asserted that we need education for our people and protection for our forests. We have seen Legislature after Legislature refuse to give laws for forest protection, because, he said, the laws that had been proposed did not seem to be what was needed for the various parts of the State. In concluding, Mr. Grimes moved that the President be requested to appoint a Legislative Committee to consult with the Attorney-General in outlining a law which will fill the needs for forest protection for the various parts of the State.

This motion was then put by the President, and was carried with enthusiasm. The following committee was subsequently named by the President: Mr. Alston Grimes, of Pitt; Mr. C. C. Smoot, III, of Wilkes; Mr. G. C. Speight, of Craven; Mr. Hugh MacRae, of New Hanover; Mr. Thomas A. Cox, of Jackson.

Ex-Governor Thomas J. Jarvis was then called upon by the President to say a few words. He said that he was glad to be present; that he made it a business to be present when there was anything for the good of North Carolina going on. He said that this meeting reminded him of the truism that the value of a gift is never really appreciated until it has slipped away from us. The people of North Carolina are in that condition. They have seen their forest wealth swept away and now they are beginning to take better care of the remnant. With properly directed efforts the forests may yet be preserved. They reproduce rapidly and with adequate laws to protect the forests the men who are now interested in this work can accomplish this end. The Governor said that he had been able to learn something at this meeting, and that he had come out to it as soon as he heard of it. He hoped that the Association would grow and increase in influence in order to protect the forests that are left and to secure others.

Mr. D. A. White, of Mebane, representing the Southern Furniture

Manufacturers' Association, said that his Association wished to coöperate with us in every way possible. His Association, he said, represents about two hundred factories, mostly in North Carolina, which are turning out furniture and allied articles. Mr. White gave a sketch of the furniture industry in North Carolina and spoke of himself as the father of the chair industry in the South. He was greatly interested in seeing the forests preserved and pledged the coöperation of the Southern Furniture Manufacturers' Association in the efforts of the Forestry Association to protect and preserve the forests of the State.

Mr. Z. W. Whitehead, of Wilmington, editor of the *Southern Lumber Journal*, spoke for the lumber fraternity and pledged their support in this movement. Thinking that the lumbermen as a class had been reflected upon in one of the talks, Mr. Whitehead defended the North Carolina lumbermen from the charge of vandalism. The average lumberman, he said, is not so ruthless as might be thought. He had found the sawmill men a great deal more conscientious than the fire vandal. The State suffers very much more from the firebug than from the acts of the lumberman.

The meeting was then adjourned, notice being given by the President of the illustrated lecture of Mr. J. G. Peters in the Auditorium at eight o'clock in the evening.

EVENING SESSION.

The evening session of the Convention was held in the Auditorium. In the absence of the President, Mr. J. S. Holmes, Secretary of the Association, introduced Mr. J. G. Peters, of the United States Forest Service, to an audience of something over two hundred people, including a considerable number of school children.

Mr. Peters then gave the following short introductory address on the general principles of forestry, which was followed by an illustrated lecture:

GENERAL PRINCIPLES OF FORESTRY.

BY J. G. PETERS, UNITED STATES FOREST SERVICE.

Members of the North Carolina Forestry Association, Ladies and Gentlemen:

The question is often asked, "What is Forestry?" which reminds me of an incident that happened soon after I arrived at New Haven to enter the Yale Forest School, something over ten years ago. Those were the early days, and the school had yet to graduate its first class. Walking across the campus I met a friend, then in college, from my home city, Baltimore. He wanted to know what I was doing up there, and I replied that I was studying forestry. "Forestry!" he exclaimed; "Forestry! for heaven's sake, what's forestry?" Although forestry is a much commoner word now than it was then,

still there is yet a generally vague idea of what forestry really is. In its broad meaning, forestry is simply the growing of trees for profit. Trees are considered as a crop of the soil, and the chief aim of forestry is to grow as much timber as possible in the shortest period of time.

In the practice of forestry a number of fundamental principles are considered. The first is that forests should eventually occupy only lands unsuited for agriculture. No forester will contend that rich soil, more profitable for growing agricultural crops, should be grown to trees. There are vast areas in forest in the South that are suited only for the production of timber; there are vast areas now in forest which will ultimately be used for agriculture; and also there are areas of cleared land that are better suited for the production of timber than for agriculture. Land should eventually be put to the use to which it is best suited. Real forest land should be kept in timber; real farming land eventually cleared. But, so long as any farming land remains forested it should be made to produce the largest possible amount of timber.

Another principle of forestry is that the amount of timber cut from a forest in a given period should not exceed the amount grown by the forest in that period; the forest is producing capital from which only the interest should be taken. Considerable cutting may be necessary for the improvement of the forest; many trees may be removed to give others a chance to grow, and low grade trees taking up valuable space may be eliminated.

Perhaps the greatest principle of forestry is that the cutting should be done in such a way that the forest will reproduce itself or, in other words, grow timber continuously.

Now, in order to practice forestry, and this is the point I wish to emphasize in particular, we must prevent the forest from burning up. Fire protection is a large part of the foundation on which the practice of forestry stands. Protection is the first law of forestry. Obviously it is unwise to make an investment in the form of conservative lumbering, or planting, or the like, if one is not reasonably sure that fire will not come along and destroy it. It has been estimated that the loss each year from forest fires in the United States averages more than 10,000,000 acres burned over and \$20,000,000 worth of property damaged or destroyed. In North Carolina the average yearly loss probably exceeds a half million dollars.

I am going to show a number of views which I have selected for the purpose chiefly of illustrating the good results from keeping fire out of the forest as compared with the great damage that may come through lack of protection. The first set of pictures will show virgin forests in North Carolina; the second set, the lumbering of the forest; third, the effects of fire and measures for prevention; fourth, the effects of erosion; and lastly, the practical application of the methods of forestry where fire and erosion have been prevented.

About seventy-five views, principally of North Carolina (furnished by the United States Forest Service), many of them colored, were then shown, and a short explanation made of each one by Mr. Peters.

This is the first illustrated lecture that has been given in Raleigh's new Auditorium, and so far as the Association is aware, is the first

public illustrated lecture on forestry given in Raleigh. The lantern used at the lecture was kindly loaned by Dr. Rankin, of the State Board of Health.

About seventy delegates were registered as in attendance on the convention, representing nineteen counties of the State, besides two delegates from Virginia. The following bodies were represented by delegates:

North Carolina State Federation of Women's Clubs, Southern Furniture Manufacturers' Association, North Carolina Farmers' Alliance, After School Club, North Carolina Pine Association, Mecklenburg Pine Beetle Association, Southern Pines Civic Club, Woman's Clubs of Raleigh and Greensboro, Chambers of Commerce of Raleigh, Greensboro, and New Bern, Norfolk and Western and Atlantic Coast Line railroads.

EXTRACTS FROM LETTERS RELATING TO FORESTRY

The following extracts from the letters of some of those who were invited to attend the Convention are here given, not only because they show the general and growing interest in the subject of forest protection, but also because they contain some valuable suggestions, and convey words of encouragement and sympathy.

Honorable H. S. Graves, Chief United States Forester, wrote:

"I appreciate very much your invitation to the annual meeting of the North Carolina Forestry Association on February 21st. I am awfully sorry that I can not accept the invitation, because it is going to be impossible for me to do more than meet the engagements which I already have ahead.

"If I were present I should call especial attention to the fact that under the present conditions the Southern States are not able to take advantage of the offer of the Government to aid in fire protection under the Weeks law. I think that this could be used as a very strong argument looking to fire protection under State direction."

Dr. Haven Metcalf, Pathologist in Charge, United States Bureau of Plant Industry, who was invited to address the Convention on the Chestnut Bark Disease, wrote:

"Your letter of the 7th was duly received, and I have given it very careful consideration. I regret very much that it is impossible for me to come myself, or send you a man for the meeting of your Association, as it seems necessary to have every one at Harrisburg who has any knowledge of the disease. I regret very much being unable to be present myself, as there is a good deal to be said on the subject of the chestnut bark disease, and I have little doubt that it will reach North Carolina by another year."

Honorable W. W. Finley, President of the Southern Railway, who was invited to address the convention on "The Close Relationship Be-

tween the State, the People, and the Railroads in the Prevention of Forest Fires," and who was prevented by sickness in his family, wrote in part as follows:

"I am, as you know, intensely interested in conservative forestry and the adoption of scientific methods of forest management throughout the South-eastern States. I believe it is of the utmost importance to our section that its forests should be so managed as to be a perpetual source of supply for raw materials for woodworking industries of all kinds. I am convinced that, with the upward tendency of lumber values, owners of forest lands will find it profitable to adopt conservative methods.

"If a suitable opportunity shall present itself during the sessions of the convention, I shall be glad to have you express my great interest in the whole subject and my regret that circumstances are such that I can not be present."

A telegram was received from the president of the John L. Roper Lumber Company as follows:

"Very much regret enforced absence from Forestry Convention. Consider your suggestion regarding fence law is of utmost importance to all land-owners as well as lumbermen. Wish you success.

(Signed) "C. I. MILLARD."

Mr. F. W. Besley, State Forester of Maryland, wrote:

"The conference at Harrisburg on February 20-21, in regard to the chestnut bark disease, which conference I have agreed to attend, will not permit me to accept your very kind invitation to address the North Carolina Forestry Association at its regular meeting in Raleigh, February 21st.

"I have often felt that here in Maryland we are very much isolated in forestry work, as the States which are showing the most interest in forestry are the Northern States, in which the forest problems are quite different from those that exist here. It is, therefore, very gratifying to know that North Carolina is taking up the work so earnestly, and I hope that Virginia may do likewise before long. This gives us a certain bond of sympathy and community of interests that can not fully exist with the Northern States, which have problems so different from those we have in the South. This will be an added disappointment in not being able to meet with you in the discussion of the problems that are of mutual interest.

"I trust, however, that you may have a very interesting and profitable meeting, and that under the stimulus of the coöperative arrangement of the Weeks law that you may develop a plan which will be of great benefit to North Carolina."

Mr. L. T. Nichols, General Manager of the Carolina and Northwestern Railway wrote:

"I wish to assure you that we are heartily in sympathy with the work and are willing to coöperate with you in any manner our limited resources will permit."

But the citizens of our own State took no less interest than those from outside. A letter from the Secretary of the State Board of Public Charities, who is also a prominent clubwoman, is here given in full because it gives a good idea of what the women of the State have done, are doing, and are willing to do for the cause of forestry education.

"I thank you for the appointment as a delegate to the annual meeting at Raleigh. I shall take pleasure in attending the sessions.

"You know that the State Federation of Women's Clubs (about three thousand women) are interested in the subject of Conservation, and that there is a Forestry Committee in that Federation. This committee consists of Mrs. W. G. Smith, chairman, Asheville; Mrs. T. P. Harrison, President of the Raleigh Woman's Club, Raleigh; Miss Adelaide Fries, Winston-Salem; Mrs. W. J. Cocke, Asheville, and Mrs. W. G. Rogers, Charlotte. Mrs. W. J. Cocke, of Asheville, is the most interested and was chairman for three years, but we have time limits in our appointments and so she was obliged to be put on as a member merely, and the time limit took me off. But we have not lost our interest, and Mrs. Cocke as chairman last year tried to get a Chair of Forestry established at the University. I have the very beautifully written resolutions passed by the Federation in favor of this chair and the report. Mrs. Cocke had letters from Governor Kitchin, Judge Clark, Senator Simmons, Hon. J. Y. Joyner, Senator Overman, Judge Pritchard, Hon. W. C. Dowd, Governor Newland, and Dr. Joseph Hyde Pratt, endorsing the movement for a Chair of Forestry. A number of papers also wrote in favor of it, and the only trouble seemed to be *funds* sufficient for the new departure. It is probable that an endorsement by the Forestry Association of this movement coming from the Federation would greatly help the ladies and would serve as a bond between the working forces in the two organizations.

"Wishing you much success.

(Signed)

DAISY DENSON."

Three of our State Senators wrote as follows:

"I thank you very much for the invitation, and if I had not already made an engagement for that date, I would most certainly be with you. I am greatly interested in the question of forestry, and while I was abroad last summer I studied the modes, ways and means of the great German Empire and her great forests and posted myself about this great question which America must very soon take up and take up in earnest.

"Trusting that your meeting will be a success in every way, I am,

"Very sincerely yours,

A. H. BOYDEN."

"I regret very much that it is impossible for me to attend the Forestry Convention which is to meet in Raleigh on the 21st, owing to court which I can not neglect. I thoroughly and deeply sympathize with the movement, and had hoped to be able to contribute some of my services to the worthy work being done in the country. With highest regards and very best wishes, I am,

"Yours truly,

J. FRANK RAY."

"I hope you will have a successful meeting which will result in a great deal of good in the protection of our forests. If there is any aid that I may be able in the future to give along this line I will be glad to do so.

"Respectfully,

J. C. FISHER."

Two prominent lawyers wrote:

"I am heartily in sympathy with this movement, as I can see where great good will result to the country by concerted action taken by the Association to check the destruction of so much forest by forest fires in this State.

(Signed) GEORGE H. SMATHERS."

"This is one of the most vital matters which affect the interest of our people. It was only a few nights ago that I saw the forest fires in the mountains near here, which was a very sickening sight.

"While I can not be personally present with you, you have my sympathy and influence, whatever it may be, and will try and meet with you on some future occasion.

(Signed) A. M. FRYE."

The Vice-President of the Southern Power Company wrote:

"I regret very much that I will not be able to attend the Forestry Association meeting at Raleigh on Wednesday, the 22d, as I have to be in New York at that time. I wish, however, every success to the organization, and I am glad to note that the people in this section here are taking a great deal more interest in this matter.

(Signed) W. S. LEE."

And one of the State's foremost educators wrote:

"I appreciate your appointment of me as a delegate. I had hoped that my engagements would allow me to attend, but I find to my regret that it will be impossible.

"With all good wishes for the success of your important work,

(Signed) WM. LOUIS POTEAT,

"President Wake Forest College."

FOREST FIRES IN NORTH CAROLINA DURING 1911

BY J. S. HOLMES, FORESTER.

INTRODUCTION

During the past three years the State Geological and Economic Survey has collected statistics on the extent of the damage done by forest fires in North Carolina. These figures for 1909, collected in coöperation with the United States Forest Service, together with a short study of the various kinds of injury done by fire, an inquiry into the common causes of fires and a few suggestions as to the best methods of preventing and extinguishing forest fires were published by the Survey as Economic Paper No. 19. The statistics for 1910 which were collected by the Survey alone, were published as Economic Paper 22, "Forest Fires and Their Prevention." This publication also contains a review of some of the educational and legislative measures which are calculated to help reduce the fire risk, the State law on the subject of forest fires which is now operative, as well as three proposed laws. A limited number of both bulletins are still available for distribution.

The figures on forest fires for 1911 have been gathered in the same way as in previous years, *i. e.*, from voluntary correspondents. Many of the earlier correspondents have dropped out, while others have been added to the list. The valuable assistance rendered by the North Carolina Forestry Association, which furnished complete lists of correspondents for about one-fourth of the counties of the State, has added considerably to the accuracy of the figures, though until such lists can be obtained for every county no attempt at completeness can be claimed for these statistics.

The object in collecting and publishing these figures is not to give exact information on the subject, as under present conditions that is impossible, but to draw the attention of the general public to the extent of the damage done by forest fires, with the hope of gradually bringing about better conditions.

THE WEATHER

As the weather is one of the chief factors in the fire risk, a glance at weather conditions during 1911 is here given.

The United States Weather Bureau thus summarizes conditions for the past year:

"The year was an exceptional one in temperature and precipitation. A number of records were broken. The average annual precipitation, 42.68

inches, was less than any previous record; a peculiar coincidence in this connection is the fact that the four driest years of record have been at intervals of seven years, viz: 1890, 1897, 1904, and 1911. * * * There was a marked deficiency in precipitation from January to October 10th, with the exception of a very slight excess in April and August, but it was somewhat above normal during the remainder of the year. During the summer and early fall the water supply was affected in some localities, but the distribution of precipitation, in slight showers, was generally sufficient for surface requirements."

These well distributed showers also served to assist in keeping down the damage done by forest fires, which, gauged by precipitation alone, should have been more disastrous in 1911 than ever before. As a matter of fact, many counties, especially in eastern North Carolina, did suffer very seriously, the newspapers reporting excessive damage in March, April, June, and July. Unfortunately, figures from many of the counties which have suffered the most in eastern North Carolina have not been secured, so that the statement for this year is decidedly incomplete.

TABULAR STATEMENT

From the following tables it will be seen that the returns have been very incomplete, only one-third of the townships being reported on in any way. The remaining townships have no doubt men in them who would be willing to assist in this effort to educate the public towards better treatment of our forests, but they have not offered to help and their names have not been suggested by friends of the movement.

If this is read by any who would be willing to help, it is hoped that they will notify the Forester, North Carolina Geological and Economic Survey, Chapel Hill, N. C., who will be only too glad to secure their coöperation in the future.

TABLE 1.—FOREST FIRES IN NORTH CAROLINA DURING 1911. COMPARATIVE STATEMENT. SUMMARY OF REPORTS FROM CORRESPONDENTS BY REGIONS, FOR 1911, 1910, AND 1909.

	Mountain			Piedmont			Coastal Plain			State		
	1911	1910	1909	1911	1910	1909	1911	1910	1909	1911	1910	1909
Total number of townships in region.....	166	166	---	450	450	---	364	364	---	980	980	---
Number of townships reporting.....	59	51	---	161	146	---	112	131	---	332	328	---
Number of replies received.....	70	48	47	179	142	61	119	131	50	367	321	158
Number of forest fires reported.....	189	136	249	249	288	86	199	312	272	637	708	607
Total area burnt over, in acres.....	41,100	80,825	166,265	32,424	188,948	100,070	86,725	339,780	139,100	180,225	579,553	406,066
Total standing timber destroyed in M. ft. bd. measure.....	10,639	6,915	17,325	4,496	12,553	11,027	23,418	42,550	9,280	38,560	62,018	27,632
Value of timber destroyed in dollars.....	\$ 36,440	\$ 25,095	\$ 47,520	\$ 12,997	\$ 35,930	\$ 33,374	\$ 64,631	\$108,965	\$ 26,360	\$114,060	\$170,020	\$ 107,264
Area of young growth destroyed, in acres.....	7,252	7,190	13,100	16,623	55,712	14,555	40,190	78,735	27,060	64,065	141,637	54,705
Value of young growth destroyed, in dollars.....	\$ 12,380	---	---	\$ 20,325	---	---	\$ 78,260	---	---	\$110,955	---	---
Value of forest products destroyed, in dollars.....	\$ 44,680	\$ 28,215	\$ 17,075	\$ 41,045	\$100,415	\$ 39,425	\$ 90,233	\$129,545	\$ 30,245	\$175,965	\$358,175	\$ 86,745
Value of improvements destroyed, in dollars.....	\$ 10,410	\$ 19,375	\$ 26,550	\$ 16,120	\$ 25,615	\$ 14,750	\$ 21,200	\$ 53,905	\$ 17,105	\$ 47,730	\$ 98,795	\$ 58,405
Total damage reported, in dollars.....	\$103,910	\$ 72,695	\$ 91,145	\$ 90,490	\$161,960	\$ 87,549	\$254,300	\$392,345	\$ 73,710	\$448,700	\$826,990	\$ 252,404
Number of lives lost.....	---	1	---	---	1	---	1	3	---	---	5	---
Cost to private individuals to fight fire.....	\$ 1,965	\$ 13,165	\$ 6,650	\$ 2,327	\$10,503	\$ 1,069	\$ 6,790	\$ 11,780	\$ 6,355	\$ 10,780	\$ 35,438	\$ 14,064

TABLE 2.—FOREST FIRES IN NORTH CAROLINA DURING 1911. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.

MOUNTAIN REGION.

COUNTY.	Total No. of Townships in County	No. of Townships Reporting	No. of Replicas	No. of Fires.	Total area burnt over	Merchantable Timber Destroyed, M	Value of Timber Destroyed	Area of Young Growth Destroyed, in Acres	Value of Young Growth Destroyed	Value of Products Destroyed	Value of Improvements Destroyed	Lives Lost	Cost of Fighting Fire
Alleghany.....	8	1	2	10	100	50	\$ 200	50	\$ 200	\$ 400	\$ 500		\$ 50
Ashe.....	15	1	1	0									
Avery.....	7	2	3	2	300	500	500	200	200	400	2,000		
Buncombe.....	13	5	5	10	1,300	30	120	400	50	200	200		100
Cherokee.....	6	3	5	93	5,800	50	75	1,100	100	1,175	50		110
Clay.....	5	2	2	2	1,000	40	60	200	400	1,000	100		150
Graham.....	3	1	1	0									
Haywood.....	13	4	4	7	3,750	30	120	150	1,300	1,500	150		150
Henderson.....	8	3	3	3	200								5
Jackson.....	15	3	2	13	3,200	30	150	200	100		25		50
Macon.....	11	3	3	4	2,200								
Madison.....	16	13	14	17	10,450	7,784	24,590	3,550	4,200	35,185	6,175		510
Mitchell.....	9	5	5	6	300			150	200				100
Swain.....	5	2	3	3	10,000	2,000	10,000	1,000	5,000	4,000	1,000		500
Transylvania.....	9	3	3	3	50			2	30				10
Watauga.....	12	2	4	0									
Yancey.....	11	6	10	16	2,450	125	625	250	600	820	210		230
Total.....	166	59	70	189	41,100	10,639	\$36,440	7,252	\$12,380	\$44,680	\$10,410		\$1,965

TABLE 3.—FOREST FIRES IN NORTH CAROLINA DURING 1911. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.

PIEDMONT REGION.

COUNTY.	Total No. of Townships in County	No. of Townships Reporting	No. of Replies	No. of Fires	Total area burnt over	Merchantable Timber Destroyed, M	Value of Timber Destroyed	Area of Young Growth Destroyed, in Acres	Value of Young Growth Destroyed	Value of Products Destroyed	Value of Improvements Destroyed	Lives Lost	Cost of Fighting Fire
Alamance.....	13	3	3	0			\$		\$	\$	\$		\$
Alexander.....	8	5	5	2	120	5	15	120	1,100	300			70
Anson.....	8		0										
Burke.....	11	1	1	0									
Cabarrus.....	12	4	7	2	200	50	200	100	50	500	100		40
Caldwell.....	12	3	1	0									
Caswell.....	9	3	3	0									
Catawba.....	8	6	8	1	35	25	30	10	50				
Chatham.....	14	4	3	4	145	100	200	20					
Cleveland.....	11	10	13	7	190	375	1,225	50	600	1,500	5,000		
Davidson.....	17	1	1	1	2					2,000			
Davie.....	7	6	10	4	115		100	25		200			
Durham.....	6	1	1	1	200								
Forsyth.....	14	3	3	1		35				420	1,000		
Franklin.....	10	6	6	91	1,585		300	900	2,100		5,050		525
Gaston.....	6	2	2	2	600								
Granville.....	9	5	7	4	200	100	500	100	500	1,500			
Guilford.....	18	2	2	0									
Iredell.....	16	4	4	10	795	166	517	360	1,425	25,800	1,000		200
Lee.....	7	4	3	4	525	320	1,000	310	3,050	200	1,000		225
Lincoln.....	5	3	3	0									
McDowell.....	10	3	4	7	225	50	200	10	100	100			
Mecklenburg.....	15	7	8	2	3			3	75				
Montgomery.....	11	3	3	1	500	15	75	100	100	425	20		5
Moore.....	9	3	3	8	10,000			10,000					50
Orange.....	7	1	2	3	5						50		2
Person.....	9	2	2	0									
Polk.....	6	6	5	42	7,500			500	500				50
Randolph.....	19	4	3	2	2,000	2,000	4,000	1,500	3,000				200
Rockingham.....	11	2	2	0									
Rowan.....	14	7	8	5	410			200	2,000				50
Rutherford.....	12	5	2	0									
Stanly.....	8	2	2	5	306	150	300	150	1,025	2,500	1,000		
Stokes.....	8	2	2	1	500		2,000			2,000			
Surry.....	14	9	13	9	3,063	555	660	50	50		1,000		205
Union.....	9	1	1	0									
Vance.....	8	2	2	0									
Wake.....	19	1	1	3	150			100	500				
Warren.....	12	2	2	2	200	50	175	100	200	600			25
Wilkes.....	20	15	17	19	2,750	500	1,500	1,840	3,300	3,000	600		700
Yadkin.....	8	8	10	6	100			75	500		300		
Total.....	450	161	179	249	32,424	4,496	\$12,997	16,623	\$20,325	\$41,045	\$16,120		\$2,327

TABLE 4.—FOREST FIRES IN NORTH CAROLINA DURING 1911. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.

COASTAL PLAIN REGION.

COUNTY.	Total No. of Townships in County	No. of Townships Reporting	No. of Replies	No. of Fires	Total area burnt over	Merchantable Timber Destroyed, M	Value of Timber Destroyed	Area of Young Growth Destroyed, in Acres	Value of Young Growth Destroyed	Value of Products Destroyed	Value of Improvements Destroyed	Lives Lost	Cost of Fighting Fire
Beaufort.....	6	2	2	15	11,000	1,000	\$ 3,000	11,000	\$34,000	\$ 1,000	\$ 5,000	—	\$ 250
Bertie.....	9	5	6	5	880	110	300	325	650	500	550	—	110
Bladen.....	15	3	3	13	5,400	2,700	5,000	6,350	11,150	5,000	500	—	—
Brunswick.....	6	4	3	11	8,500	5,025	22,050	7,500	10,000	25,000	200	—	325
Camden.....	3	—	0	—	—	—	—	—	—	—	—	—	—
Carteret.....	9	—	0	—	—	—	—	—	—	—	—	—	—
Chowan.....	4	3	2	2	100	0	—	100	1,000	—	—	—	25
Columbus.....	14	3	5	5	1,200	300	900	1,200	2,200	1,350	1,000	—	1,000
Craven.....	9	2	5	2	300	150	600	—	—	—	—	—	50
Cumberland.....	11	4	4	8	510	—	—	—	—	3,000	—	—	65
Currituck.....	5	3	3	0	—	—	—	—	—	—	—	—	—
Dare.....	5	—	0	—	—	—	—	—	—	—	—	—	—
Duplin.....	13	5	2	10	1,500	600	1,300	1,300	800	1,300	500	—	150
Edgecombe.....	14	1	1	0	—	—	—	—	—	—	—	—	—
Gates.....	7	1	2	15	2,000	0	—	1,500	—	2,000	—	—	300
Greene.....	10	2	2	4	1,000	20	100	500	5,000	15,000	—	—	100
Halifax.....	12	—	0	—	—	—	—	—	—	—	—	—	—
Harnett.....	13	6	7	8	3,000	75	225	50	200	1,000	—	—	50
Hertford.....	6	2	3	8	700	300	1,200	200	200	2,000	550	—	225
Hoke.....	5	1	1	0	—	—	—	—	—	—	—	—	—
Hyde.....	4	2	3	2	2,000	100	250	1,100	1,000	—	500	—	—
Johnston.....	16	10	9	8	500	2,500	4,890	575	900	2,000	3,000	—	1,000
Jones.....	7	1	1	1	5,000	50	100	—	—	100	—	—	—
Lenoir.....	12	4	4	6	2,150	100	300	150	1,500	5,000	—	—	500
Martin.....	10	—	0	—	—	—	—	—	—	—	—	—	—
Nash.....	12	8	8	8	645	70	300	505	425	—	50	—	—
New Hanover.....	4	—	0	—	—	—	—	—	—	—	—	—	—
Northampton.....	9	3	4	4	5,010	2,500	5,000	10	100	—	50	—	110
Onslow.....	5	3	3	14	10,000	630	800	3,200	900	75	475	—	350
Pamlico.....	4	3	2	2	5,000	250	500	2,500	500	2,000	200	—	500
Pasquotank.....	6	2	2	0	—	—	—	—	—	—	—	—	—
Pender.....	10	1	1	1	9,000	1,500	4,500	—	—	—	—	1	—
Perquimans.....	5	1	2	0	—	—	—	—	—	—	—	—	—
Pitt.....	11	4	6	15	2,325	1,120	3,250	525	1,625	16,700	1,200	—	750
Richmond.....	7	1	1	4	500	—	—	—	—	500	5,000	—	500
Robeson.....	19	8	7	19	5,425	4,090	9,160	3,400	6,100	4,500	1,225	—	105
Sampson.....	16	4	4	3	900	8	16	—	—	1,008	—	—	25
Scotland.....	4	1	1	0	—	—	—	—	—	—	—	—	—
Tyrrell.....	5	—	0	—	—	—	—	—	—	—	—	—	—
Washington.....	4	1	2	1	2,000	—	—	—	—	—	—	—	300
Wayne.....	12	4	4	2	—	—	—	—	—	—	—	—	—
Wilson.....	10	4	3	3	210	220	880	200	—	1,200	1,200	—	—
Total.....	364	112	119	199	86,725	23,418	\$64,621	42,190	\$78,250	\$90,223	\$21,200	1	\$6,790

FOREST FIRES AND THEIR PREVENTION.
TABLE 5.—COMPARATIVE STATEMENT OF AVERAGES BY REGIONS FOR 1911, 1910 AND 1909.

	Mountain			Piedmont			Coastal Plain			State		
	1911	1910	1909	1911	1910	1909	1911	1910	1909	1911	1910	1909
Percentage of townships reporting.....	35	31	-----	36	32	-----	30	36	-----	335	33.5	-----
Average area of each fire, in acres.....	217	594	668	130	616	1,171	436	1,069	511	250	821	667
Average damage by each fire, in dollars.....	\$ 5.50	\$ 6.31	\$ 3.93	\$ 3.63	\$ 6.08	\$10.30	\$12.78	\$ 9.74	\$ 2.94	\$ 7.06	\$ 7.75	\$ 4.39
Average area burnt over per township reporting, in acres.....	697	1,585	-----	201	1,069	-----	774	2,594	-----	483	1,805	-----
Average damage per acre burnt, in dollars.....	\$ 2.53	\$ 1.06	\$.59	\$ 2.79	\$ 1.08	\$.88	\$ 2.93	\$.90	\$.57	\$ 2.80	\$.97	\$.66

From the foregoing tables it is seen that the number of fires reported is practically the same as for the two previous years, and most of the other figures correspond fairly closely, showing that the annual damage from forest fires is not decreasing at any appreciable rate. The most notable thing about these figures is the reduction in the amount of land burned over by each fire, and, consequently, the large total reduction in area burned over, this being less than one-third of what was burned in 1910.

The total amount of damage done by the fires that were reported is estimated at \$428,000, which is less than the damage for 1910, but considerably more than that given for 1909. The average damage per acre has largely increased, being \$2.80 for the whole State. One reason for this large increase is that the figures for 1911 include estimates of damage done to young growth, which were not included in the earlier figures.

One remarkable thing about these figures is the comparative uniformity of the reports coming from the different regions of the State, showing that they are not the result of exaggerated ideas of a few correspondents, but represent the opinion of the average citizen of North Carolina.

Though some sections of the State were singularly free from fires during the past year, others suffered extreme injury. This is especially true of some of the eastern counties, several of which have unfortunately failed to report. The accounts of fires, appearing in the daily papers last summer, which occurred in Carteret, Dare, Pasquotank, Perquimans, Tyrrell and other counties, none of which are reported here, makes one realize that the figures given are much below the actual amount, and convinces one that strong measures should be taken at once to reduce this enormous annual loss.

CAUSES OF FOREST FIRES

The principal causes of forest fires as given by the various correspondents for their own townships have been compiled. They are given in percentages in Table 6, and are compared with similar figures for the two preceding years.

TABLE 6.—CAUSES OF FOREST FIRES IN THE DIFFERENT REGIONS OF NORTH CAROLINA IN 1911 COMPARED WITH FORMER YEARS, IN PERCENTAGES.

	1911				1910	1909
	Moun- tain	Pied- mont	Coas- tal	State	State	State
Farmers burning brush, grass, rubbish, etc.....	17	16	9	13	13	10
Hunters.....	17	6	10	10	6	16
Cigars, cigarettes, matches, etc.....		4	4	3	3	3
Carelessness and negligence of individuals.....	16	25	20	20	20	15
Railroad locomotives, sparks from.....	10	19	31	22	20	17
Logging locomotives, dummy engines, etc.....	7	6	13	9	9	5
Sawmills, etc.....	3	8	3	4	5	3
Traction engines.....					1	
Accidental, caught from burning buildings, etc.....					1	1
To improve the range.....	3	2		2	3	4
Set by chestnut gatherers, root diggers, etc.....	7			2		2
Without much object, to see it burn, etc.....	3			1	2	13
Malice or incendiary.....	10	2	3	4	9	4
Unknown causes.....	7	8	3	6	8	7
Lightning.....		4	3	3		
Fishing camp fires.....			1	1		

The two most notable facts that can be gathered from the above table are: (1) The large proportion of fires which are started from farmers carelessly burning brush, grass, and rubbish in the spring; (2) the large and increasing percentage of fires started by railroads.

As can be seen by a glance at the first four items in the table, fires caused by carelessness and negligence of the individual constitute about one-half of the total causes given. Practically all of the fires under the fourth heading should be attributed to one of the three former causes and probably most of them to the carelessness of farmers in clearing up farm land in the spring. It is this carelessness of farmers and renters, assisted by the usual high winds and frequently by dry weather, that makes the spring months by far the most dangerous, fires at this time of the year being more frequent and much more destructive than at any other season.

The following table, compiled from replies from the correspondents to the question "In what month or months did the worst forest fires occur

(in 1911)?" indicates pretty clearly what is the danger season in North Carolina.

TABLE 7. RELATIVE FIRE RISK IN 1911, BY MONTHS AND SEASONS, IN PERCENTAGES.

March	14	} Spring 57	June	9	} Summer 26
April	27		July	10	
May	16		August	7	
September	7	} Fall 14	December	2	} Winter 3
October	4		January	0.5	
November	3		February	0.5	

The largest number of fires attributed to any one cause are laid to sparks from railroad locomotives, twenty-two per cent being attributed to this cause, an increase of two per cent over the year 1910, and of five per cent over the year 1909. This increased proportion is still greater if the logging railroads are included. Forty-four per cent of all the fires in the Coastal Plain region are attributed to locomotives, while in the mountain counties this number is reduced one-half. The great increase of the proportion of railroad fires may be due rather to the reduction of the number of fires from other causes than to the actual increase in the number of fires from this cause. It is evident, however, that the railroads are a great menace to the forests of the State, and a determined effort both on the part of the people and on the part of the railroads should be made to remedy this evil. A suggested law for the suppression of forest fires which is reprinted from Economic Paper No. 22 is given herewith, with the hope that the intelligent public will study this matter, and will call the attention of their next representatives in the General Assembly to their need of such laws. The protection of the forests from fire depends first of all upon the people. If they want to stop the frequent and destructive fires, the State Government will help them; that is what it is for. But they must show in some way that they desire such assistance, and they can do that best by appealing to their representatives.

SUGGESTED FORESTRY LEGISLATION

The following chapter was prepared for and published in Economic Paper No. 22, "Forest Fires and Their Prevention." This bulletin has been distributed so widely over the State that the original edition is nearly exhausted.

As the question of Forest Fire laws will no doubt occupy the attention of many people during the coming political campaign and subsequently, it is hoped, of the entire Legislature also, it has been thought best to publish the part of this paper relating to present proposed forest fire laws as a part of Economic Paper 25 rather than reprint the whole of Economic Paper 22, much of which is superseded by the report on forest fires for 1911 which is included in this present bulletin.

The proposed laws are given not as legislation which must be adopted or rejected as a whole, but rather as suggestions to aid in the formation of public opinion, and possibly as a basis from which to build a much needed law which may be adapted to all portions of our State. It may be said of the railroad law, however, that it was highly commended by the Federal Forest Service, and during the session of the last Legislature it firmly withstood the criticisms of the more important railroads of the State.

PRESENT LAWS RELATING TO FORESTRY

In 1777 the General Assembly of North Carolina passed a statute making it unlawful for any one to set fire to the woods, except it be his own property, and in that case not without first giving two days notice in writing to adjoining property owners. After one hundred and thirty-four years this law still remains on our statute books, the best and practically the only law we have on the subject. In its present form in The Revisal of 1905 it reads:

SECTION 3346. Woods.—If any person shall set fire to any woods, except it be his own property or, in that case, without first giving notice in writing to all persons owning lands adjoining to the woodlands intended to be fired, at least two days before the time of firing such woods, and also taking effectual care to extinguish such fire before it shall reach any vacant or patented lands near to or adjoining the lands so fired, he shall, for every such offense, forfeit and pay to any person who shall sue for the same, fifty dollars, and be liable to any one injured in an action, and shall moreover be guilty of a misdemeanor.

The law, therefore, forbids setting fire to woods, even though it be one's own property, without giving two days notice in writing to adjoining land-owners. This law is rarely enforced, because the "two days notice in writing" is considered an impractical measure, and also because the strong objection among most people to prosecuting their neighbors acts as a deterrent. One of the most frequent causes of fire, that from burning brush while clearing up new grounds in the spring, is not covered by this law, for the courts have held that these "new ground" fires do not come within the stat-

ute. This law is susceptible of considerable improvement and should be amended.

Since the great extension of railroad facilities all over the State, the practice of hauling farm crops and merchandise long distances to market, which used to be the universal custom, has almost ceased. In the rougher and more remote parts of the State, however, where more than one day's trip is required to reach the market, the abandoned campfire is still a menace. That North Carolina has a law against leaving such fires unextinguished is often not known by wagoners, and a notice quoting the following section posted near frequented camping places would often be of great advantage to the passerby, as well as a safeguard to the property owner:

3347. Woods, from Camp Fires.—If any wagoner or other person encamping in the open air shall leave his camp without totally extinguishing the camp fires, he shall be guilty of a misdemeanor, and upon conviction thereof, shall be fined not exceeding fifty dollars, or imprisoned not exceeding thirty days.

These two laws, the most important dating back some one hundred and thirty years, constitute the present working forest fire laws of North Carolina. Even these, however, are rarely enforced.

SUGGESTED LEGISLATION RELATING TO FORESTRY

As we have previously seen, the largest number of fires are due to the carelessness or indifference of individuals, and to the negligence of railroads, lumbermen, and other operators of engines. In order to successfully cope with this situation, we need: (1) Better laws to control the private citizen; (2) stricter regulations controlling the railroad and other engine users; (3) a system maintained by the State, or the State and counties together, to properly enforce the forest fire laws. These three features may be combined in one act, as was done in the bill which was introduced into the last Legislature, or they may be passed as three separate acts, as is here proposed.

Fires Set by Private Individuals.—The present law, which has previously been given, should be amended to include grassland, but the two days written notice required should apply to woods only, or should be eliminated altogether. By broadening the second section to make it include hunters and other persons, some approach to controlling that fertile source of forest fires would be made.

In New Jersey and several other States to the north and west of us, the burning of woods, brush, stumps, rubbish, and other material is not allowed during a dry season, and in some cases throughout the year, without a written permit from the proper officer. This has been found to work well in preventing fires, especially the destructive early spring fires. In North Carolina, however, we are hardly ready for such a law. A law to compel all who burn material to watch it till it is extinguished would seem to meet a definite need and would be more easily enforced.

The following suggested bill contains all of the above features:

A BILL TO BE ENTITLED AN ACT TO PROTECT THE FORESTS OF THIS STATE FROM FIRE.

The General Assembly of North Carolina do enact:

SECTION 1. That section three thousand three hundred and forty-six of The Revisal of one thousand nine hundred and five be amended to read as follows:

If any person shall set fire to any grassland, brushland, or woodland, except it be his own property, or, in that case, without first giving notice to all persons owning or in charge of lands adjoining to the land intended to be fired, and also taking care to watch such fire while burning and taking effectual care to extinguish such fire before it shall reach any lands near to or adjoining the land so fired, he shall for every such offense be guilty of a misdemeanor and be fined or imprisoned in the discretion of the court. This shall not prevent action for damages sustained by the owner of any property.

SEC. 2. That section three thousand three hundred and forty-seven of The Revisal of one thousand nine hundred and five be amended to read as follows: Any wagoner, hunter, camper or other person who shall leave a campfire without fully extinguishing it, or who shall accidentally or negligently, by the use of any torch, gun, match or other instrumentality, or in any manner whatever, start any fire upon any grassland, brushland or woodland, without fully extinguishing the same, shall be guilty of a misdemeanor, and upon conviction shall be punishable by a fine of not less than twenty-five dollars nor more than fifty dollars or imprisoned not exceeding thirty days.

SEC. 3. All persons, firms or corporations who shall burn any tar kiln or pit of charcoal or set fire to or burn any brush, grass or other material whereby any property may be endangered or destroyed, shall keep and maintain a careful and competent watchman in charge of said kiln, pit, brush or other material while burning. Any person, firm or corporation violating the provisions of this section shall be guilty of a misdemeanor.

Railroad Fires.—The railroads and lumber companies, though great offenders, having caused probably one-third of the fires in the State in 1910, are also great sufferers, being generally held responsible for injury and made to pay damages. A few of the replies to the question asking about prosecutions are here quoted: "Railroad paid for several acres of timber"; "Railroad compromised, nothing done about the rest"; "No; the railroad people always pay damage"; "The railroad has paid about \$1,000"; "No; railroad company paid about \$2,000"; "The railroad company goes over the ground and sees how much it burns over, and pays about thirty-five cents per acre"; "Set by traction engine, and damage paid"; "Lumber company sued for \$5,000"; "Lumber company forced to pay damages"; "Suit entered against one lumber company." These prosecutions are, of course, as said before, brought under the civil law, and do not invoke the present fire laws. They do, however, show that it is as much to the interest of the railroads as to that of the owners of woodland that fires should be prevented. Until there is some general demand, however, that the railroads take necessary precautions, they prefer to drift along in the old way, paying damages now and then—the average cost of which they know—rather than advocate new laws, which, though they might save them money, still would cost them an unknown amount to carry out. When reasonable laws are once passed the railroads will undoubtedly cooperate actively in their enforcement, trusting thereby to cut down their large annual bill of damages.

During the last session of the Legislature the following bill was drawn up, after careful discussion and criticism of every point by the representatives of the people and of the railroad and lumber companies. It was at first introduced as part of the general forestry bill, but was later drawn up as a separate law. It is in this form that its passage by the next Legislature is strongly urged.

A BILL TO BE ENTITLED AN ACT TO REQUIRE THE RAILROADS OF THE STATE TO TAKE CERTAIN PRECAUTIONS FOR THE PREVENTION OF FOREST FIRES.

The General Assembly of North Carolina do enact:

SECTION 1. All persons, firms or corporations operating any railroad, logging road or tramroad through woodland within this State shall keep their right of way cleared of all combustible materials within a horizontal distance of one hundred (100) feet, nowhere to exceed one hundred and fifty (150) feet surface measurement, from the outer rail on each side of the track, by burning or other method. Combustible material, as referred to in this act, shall be construed to mean only such brush, grass, leaves or other material that would ordinarily become ignited from a spark from the engine. When the right of way owned does not extend to the width of the cleared space or fire line herein required, the right is hereby granted to said persons, firms or corporations to enter upon adjoining lands not owned by them, for the purpose of clearing off and maintaining the cleared space or fire line herein required. If any landowner should object to the clearing off and maintenance of the fire line herein required, he shall not be entitled to collect any damages thereafter occurring from fires caused by sparks from the engines of said persons, firms or corporations. Each railroad, logging road or tramroad affected hereby shall be required to clear off each year not more than one-fifth (1-5) of the total length of the fire line required by this section until all has been completed, and shall continue to keep such fire line clear after it has once been cleared off. The part of the mileage to be cleared off by such railroad shall be designated by the Geological Board after conference with the proper officer of such railroad, logging road or tramroad. Any railroad wilfully violating the provisions of this section shall be liable to a penalty of not less than ten (\$10.00) dollars nor more than twenty-five (\$25.00) dollars for every mile or fraction thereof of fire line not cleared according to the provisions of this section: *Provided*, that this section shall not be construed to prohibit or prevent any railroad company from piling or keeping upon the right of way, crossties or other material necessary in the operation or maintenance of such railroad or materials intended for shipment over such railroad; nor is it intended to require the removal of buildings, fences or other necessary or valuable improvements from the fire line herein required: *Provided further*, that the notice to the adjoining landowners required by section three thousand three hundred and forty-six of The Revisal of one thousand nine hundred and five shall not apply to any burning necessary to carry out the provisions of this section: *Provided, further*, that nothing in this section shall be construed to require the railroad company to clear the fire line on property not owned by said company should the owner object, and no failure on this account shall be charged against the railroad company as a violation of this act.

SEC. 2. When engineers, conductors or trainmen employed by any railroad discover that fences or other material along the right of way or woodland adjacent to the railroad are burning or in danger from fire, they shall report the same promptly at the next telegraph or telephone station at which the train is scheduled to stop, or at any other stops necessary in the operation of the train. The reporting of such fires shall not be construed to mean that the railroad companies making such report are responsible for such fires, nor shall such report be used in evidence in a suit arising from such fire, but is simply for the purpose of giving information as to the existence of a fire. In seasons of drought the railroad companies shall give instructions to their section foremen for the prevention and prompt extinguishing of fires originating on their right of way, and they shall cause warning placards, furnished by the Geological Board, to be posted at their stations in the vicinity of forest lands. Any railroad company wilfully violating the requirements of this section shall be guilty of a misdemeanor, and railroad employees wilfully violating the requirements of this section shall be guilty of a misdemeanor.

SEC. 3. For the purpose of this act woodland is taken to include all forest areas, both timber land and cut-over land, and all second growth stands on areas that have at one time been cultivated.

This law requires the railroads to clear off a strip one hundred feet wide on each side of their track, where it runs through woodland. It has been demonstrated after careful study that most of the live sparks from railroad locomotives fall within the zone between fifty and one hundred feet on each side of the track, and very few fall beyond that distance. Keeping this strip clear would then prevent most of the fires caused by railroads and logging roads, which, as we have seen above, constitute about one-third of the fires in the State.

Fire Warden System.—The most important problem in the formulation of forest laws is providing effective machinery for putting them into force. Eighteen States have already organized fire protective systems, the purpose of which is to enforce the forest fire laws of these States. Little or nothing has been accomplished in States without such systems, though several, like our own, have some excellent laws. A fire warden system generally consists of district, township, or county wardens, who, as a rule, are responsible to some one State official, either the State Forester, the State Forest Commissioner, or State Fire Warden, who is specifically charged with fire-protective work and usually also with the forestry work of the State. It is the duty of the wardens to extinguish fires, arrest offenders against the fire laws, investigate the causes of fires, post warning notices against fire, and in some cases to patrol the forests during dry weather. They are paid by the State, or by the county, or by the State and county combined, usually by the hour or day, for the time actually employed. In fixing a rate of payment, care is taken not to make it high enough to tempt unscrupulous men to set fire to the woods with the object of drawing pay for extinguishing it. This practice may, of course, be occasionally resorted to, even where the pay is not high, but an efficient county fire warden would soon discover the perpetrators, or at least have his suspicions aroused, and one or two drastic sentences, upon conviction, would put a stop to the practice. There are many counties in North Carolina where fire wardens are not needed, but in counties having fifty per cent and over of their area in woodland they would quickly pay for their cost. If only a few counties were given the advantage of such a law to start with, the demand for fire wardens would rapidly spread, as their usefulness became apparent. The following bill, in a somewhat different form, was introduced into the Legislature of 1911, but failed to pass, chiefly because a special tax of half a cent per acre on all woodlands in the State was asked, to provide revenue for its enforcement. This method of raising the necessary money is perfectly fair and equitable, but until the system can be inaugurated and tested in those counties that most need fire protection, it is thought that a direct appropriation would be much simpler and more practicable.

A BILL TO BE ENTITLED AN ACT TO AUTHORIZE THE APPOINTMENT AND PAYMENT OF FOREST WARDENS.

The General Assembly of North Carolina do enact:

SECTION 1. On petition of four or more owners of timber lands in any one township, owning in the aggregate five thousand acres or more, or the owners of one-third of the forest land in the township, the county commissioners shall appoint, subject to the approval of the Geological Board, a forest warden for that township and as many deputy forest wardens to act with him as the Geological Board may deem necessary for the proper enforcement of this act. All forest wardens and deputy forest wardens must be legal residents of the counties in which they are employed.

SEC. 2. Forest wardens and deputy forest wardens shall have charge of measures for controlling forest fires; they shall make arrests for violations of the forest laws; shall post along highways and in other conspicuous places copies of the forest fire laws and warnings against fires, which shall be supplied by the Geological Board; and they shall perform such other duties as shall be considered necessary by the Geological Board for the protection of forests. The forest wardens of the township in which a fire occurs shall within ten days make such report thereof to the Geological Board as may be prescribed by them. Each deputy forest warden shall promptly report to wardens any fire in his district.

SEC. 3. Any person who shall maliciously or wilfully destroy, deface, remove or disfigure any sign, poster or warning notice, posted by order of the Geological Board under the provisions of this or other act for the purpose of protecting the forests in this State from fire, shall be guilty of a misdemeanor and upon conviction shall be punishable by a fine of not less than ten dollars or more than fifty dollars or imprisoned not exceeding thirty days.

SEC. 4. Any person discovering any forest fire shall immediately give notice to the nearest forest warden or deputy forest warden in that or adjoining townships. All able-bodied male persons between eighteen and forty-five years of age can be summoned by forest wardens or deputy forest wardens to assist in extinguishing forest fires and shall be paid for such services at a rate not to exceed fifteen (15) cents per hour. Any person summoned by a forest warden or his deputy and not attending, without reasonable excuse, shall be subject to a fine of five (\$5) dollars.

SEC. 5. Forest wardens and deputy forest wardens shall have the same power as deputy sheriffs, so far as the provisions of this act are concerned. Neither forest wardens nor their deputies shall be liable for trespass while acting in the performance of their duties, nor shall any person be held guilty of trespass for going on lands when summoned by an officer to control fire.

SEC. 6. Forest wardens and deputy forest wardens shall receive compensation from the State at the rate of twenty cents per hour for the time actually engaged in the performance of their duties and reasonable expenses for equipment and transportation incurred in fighting or extinguishing any fire, according to an itemized statement to be rendered the Geological Board every month and approved by them. Forest wardens shall render to the Geological Board a statement of the services rendered by the men employed by them or their deputy wardens, as provided in this act, within one month of the date of service, which said bill shall show in detail the amount and character of the service performed, the exact duration thereof, the name of each person employed, and any other information required by the Geological Board. If said bill be duly approved, it shall be paid by direction of the Geological Board out of the State Treasury; and the State Treasurer is hereby authorized and required to collect one-half of the wages and expenses incurred by the forest wardens and deputy forest wardens under this section and section three (3) of this act, from the county in which they are incurred.

SEC. 7. The sum of ten thousand dollars annually is hereby appropriated, out of any moneys in the treasury not otherwise appropriated, for the purpose of carrying out the provisions of this act, the same to be drawn upon as directed by the Geological Board.

PUBLICATIONS
OF THE
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Out of print.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands, and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Waterpowers in North Carolina, by George F. Swain, Joseph A. Holmes, and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and Other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Out of print.*
11. Corundum and the Basic Magnesium Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 6 cents.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade Trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents. Cloth-bound copies 30 cents extra.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglas B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. Waterpowers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*
21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
22. A Report on the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp., 22 pl., 5 figs. *Postage 15 cents.*
23. Forest Conditions in Western North Carolina, by J. S. Holmes, 1911. 8°, 115 pp., 8 pl. *Postage 15 cents.*

ECONOMIC PAPERS.

1. The Maple Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monasite, Tungsten, Building Stones, and Coal, in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monasite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestones; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos, and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monasite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monasite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monasite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Mineral and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monasite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monasite in Original Matrix.

15. *The Mining Industry in North Carolina During 1907*, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monasite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elisabeth City, North Carolina.

16. *Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina*, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. *Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908*. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. *Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909*, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

19. *Forest Fires in North Carolina During 1909*, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pl. *Postage 5 cents.*

20. *Wood-using Industries of North Carolina*, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Postage 7 cents.*

21. *Proceedings of the Third Annual Drainage Convention, held under Auspices of the North Carolina Drainage Association; and the North Carolina Drainage Law (codified)*. Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp., 3 pl. *Postage 5 cents.*

22. *Forest Fires in North Carolina During 1910*, by J. S. Holmes, Forester, 1911. 8°, 48 pp. *Postage 3 cents.*

23. *Mining Industry in North Carolina During 1908, '09, and '10*, by Joseph Hyde Pratt and Miss H. M. Berry, 1911. 8°, 134 pp., 1 pl., 27 figs. *Postage 10 cents.*

Gives report on Virgilina Copper District of North Carolina and Virginia, by F. B. Laney; Detailed report on Mica Deposits of North Carolina, by Douglas B. Sterrett; Detailed report on Monasite, by Douglas B. Sterrett; Reports on various Gem Minerals, by Douglas B. Sterrett; Information and Analyses concerning certain Mineral Springs; Extract from Chance Report of the Dan River and Deep River Coal Fields; Some notes on the Peat Industry, by Professor Charles A. Davis; Extract from report of Arthur Keith on the Nantahala Marble; Description of the manufacture of Sand-lime Brick.

24. *Fishing Industry of North Carolina*, by Joseph Hyde Pratt, 1911. 8°, 44 pp. *Postage 5 cents.*

25. *Proceedings of Second Annual Convention of the North Carolina Forestry Association, held at Raleigh, North Carolina, February 21, 1912*. Forest Fires in North Carolina During 1911. Suggested Forestry Legislation. Compiled by J. S. Holmes, Forester, 1912. 8°, 71 pp. *Postage 6 cents.*

26. *Proceedings of Fourth Annual Drainage Convention, held at Elisabeth City, North Carolina, November 15 and 16, 1911*, compiled by Joseph Hyde Pratt, State Geologist, 1912. 8°, pp. *Postage cents.*

27. *Highway Work in North Carolina, containing a Statistical Report of Road Work during 1911*, by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, 1912. 8°, pp., figs. *Postage cents.*

VOLUMES.

Vol. I. *Corundum and the Basic Magnesian Rocks in Western North Carolina*, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. *Fishes of North Carolina*, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. *The Coastal Plain Deposits of North Carolina*, by Wm. Bullock Clark, Benjamin L. Miller, L. W. Stephenson, B. L. Johnson, and Horatio N. Parker, 1912. 8°, 509 pp., 62 pl., 21 figs.

Pt. I.—*The Physiography and Geology of the Coastal Plain of North Carolina*, by Wm. Bullock Clark, Benjamin L. Miller, and L. W. Stephenson.

Pt. II.—*The Water Resources of the Coastal Plain of North Carolina*, by L. W. Stephenson and B. L. Johnson. *In Press.*

BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble, Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Gives special report on an Examination of the Sand-banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders, of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report. Contains Agreements for Co-operation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract, Buncombe County; Transylvania County State Farm; certain Watersheds; Reforestation of Cut-over and Abandoned Farm Lands; on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county seats in North Carolina; list of Magnetic Declination at the county seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump

form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of *postage* needed, as indicated above, for mailing the bulletins desired, to the *State Geologist, Chapel Hill, N. C.*

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